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RADIOSENSITIVE EPIDERMOID CARCINOMAS*

BY JAMES EWING, M.D.

Pathologist to Memorial Hospital

NEW YORK CITY

EPIDERMOID carcinoma has generally been regarded as a group of tumors of which clinical and pathological knowledge is so comprehensive and complete that nothing new of interest may be expected. Yet, in the past few years this impression has been completely dispelled, much new interest has been excited, and new facts of importance have been elicited about these common tumor processes. Broders' scheme of classifying epidermoid carcinomas, according to the grade of potential malignancy, while based upon facts long well known, served to emphasize, with peculiar force, the dependence of prognosis upon the character of the disease rather than upon the method of treatment, and has induced many surgeons to pay more attention to the natural history of the disease and cling less to standard technical procedures.

Experience with radiation therapy has also emphasized even more clearly that there are wide differences in the therapeutic problems of epidermoid carcinoma, since some tumors prove to be very radiosensitive and others highly resistant.

New opportunities are thus opened up in the laboratory diagnosis of tumors, and the pathologist may be of service both in grading the potential malignancy of the tumor and also in estimating the degree of radiosensitivity. The surgeon and radiologist must now be provided with both these types of information, so that they may plan the treatment intelligently, and form a safe judgment of the probable outcome. In many clinics it is becoming an established practice to alter the plan of treatment according to the stage of the disease and the grade of radiosensitivity, with great advantage to the patient. Thus, Regaud treats all radiosensitive laryngeal carcinomas with radium and assigns all resistant squamous cases to surgery.

Variations in grade of potential malignancy and in radiosensitivity are observed in tumors from all parts of the body, but they are less marked in tumors of the skin than in those of mucous membranes.

Radiosensitivity usually runs parallel with the degree of potential malignancy and anaplasia, but this relation is by no means constant. In the skin, basal cell carcinoma is relatively benign, but markedly radiosensitive; however, observations on this point are not in entire agreement. All melanomas are highly malignant, and at the same time highly radioresistant, for reasons which I find it difficult to detect.

In the lip and tongue, although there are considerable variations in clinical malignancy with corresponding changes in structure, most of these carcinomas are resistant.

In the esophagus there are very wide

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variations in structure and malignancy. Most carcinomas of this organ show marked anaplasia and infiltrative powers. We find that a considerable number are, from the first, extremely anaplastic, and a few approach the very malignant round cell carcinoma. This fact encourages the treatment of esophageal cancer by external irradiation.

In the uterus all observers have noted marked differences in the structure of epidermoid carcinoma, but few have found corresponding variations in clinical course (Martzloff, Plaut). Yet Healy and Cutler brought out the striking paradox that with radiation treatment the prognosis is better with the higher grades of malignancy, because the radiosensitivity increases with the malignancy. They divided their cases into three groups, squamous, transitional cell, and anaplastic. With the squamous type there were few cures by any method and only in the early stages; in the intermediate group the results were about equal from irradiation and surgery; while in the anaplastic group there were no cures by hysterectomy, but the highest proportion, 46 per cent, by irradiation. There is no more forceful demonstration of the value of grading epidermoid cancers according to malignancy and radiosensitivity.

In the nasopharynx there are several types of epithelium lining mucous surfaces, and an equal variety of tumors arising from them. With the exception of the squamous types, all are radiosensitive and some are extremely so. In this region one encounters the cellular carcinomas of Schneiderian origin, the adenoid cystic carcinoma of the nares and antrum, the transitional cell carcinomas, and the lymphoepithelioma of Regaud and Schmincke. These tumors offer an excellent field for the study of the causes and degrees of radiosensitivity.

The Causes of Radiosensitivity. It has long been known that the main factor in radiosensitivity is a high metabolism of the tumor cells. Active mitosis and cell division are generally associated with high metabolic rate, so that most actively growing tumors are radiosensitive. The sensitivity of the growing cells is usually attributed to the vulnerability of the mitotic nucleus, and it is also probably due to instability of cell cytoplasm and the activity of cell ferments. On the other hand, squamous cells grow more slowly, their cytoplasm is compact and stable, they produce resistant keratin and fibrils and the nutrition of the tissue is stable.

The desmoplastic property of many epidermoid carcinomas is one of the most important factors in rendering them resistant and accounts for many failures to cure these tumors by irradiation. Incased in firm non-vascular connective tissue, with adequate nutrition supplied by lymph vessels and with slow growth, these cells become, as a rule, highly resistant, and the resistance increases with inadequate dosage. Sterilization of such a process requires caustic doses, or a long process of simple atrophy. Roentgen-ray cancer is notable for its resistance to irradiation, and also for its marked tendency to produce much new connective tissue. As a rule, the more adult the cell type, the more active is the stroma reaction. On the other hand, the highly anaplastic and rapidly growing cellular tumors excite very little stroma reaction and may be completely destroyed by external irradiation.

Many observers have concluded that vascularity is one of the most important factors in the destruction of tumors by irradiation. It has been shown that the physical effect of irradiation is heightened by active circulation and may be greatly diminished by compression of vessels and anemia. Tumor vessels are usually very unstable and may be ruptured or thrombosed by the direct effects of radiation or by secondary inflammation. I think this effect is particularly noticeable after roentgen irradiation, and it is seen in striking form in the late necroses following heavy gamma irradiation which produces obliterating arteritis.

Bulky papillary carcinomas melt down rapidly mainly because the delicate vessels are destroyed. I find that many of the rapidly growing radiosensitive epidermoid carcinomas also are highly vascular or the vessels are fine and delicate. These structural features suggest that sensitivity may be largely the result of asphyxia. Bulky necrosis after irradiation is nearly always the result of cutting off the blood supply.

In fact, bulky necrosis in pathological processes is nearly always of this origin.

The location of the tumor process has a very important influence on the results of irradiation. The response of the surrounding tissues has almost as much to do with the destruction of tumor cells as the effects on the cells themselves. Vascular and cellular tissues respond readily with exudation, leucocytosis and granulation tissue, in which the tumor cells perish, while fibrous and non-vascular tissues do not react well and the tumor cells are not subjected to the attack of these normal weapons of defense. Epidermoid carcinoma invading periosteum or scar tissue is a too familar example of a resistant process. In bone it is extremely difficult to destroy epidermoid carcinoma, because the inflammatory reaction is poor and osteitis develops. Fat tissue is a very unfavorable bed for the treatment of most carcinomas, because the cells grow readily in fat and this tissue yields a poor response to irradiation. Lymph nodes not only exert restraining influence on the growth of carcinoma, but they give a very active response to irradiation, with exudation of plasma cells and lymphocytes, and formation of granulation tissue and cellular connective tissue. In some cases this reaction may resemble a sarcomatous process.

The cellular vascular tissues of the tongue, tonsil and uterine mucosa are relatively favorable fields.

Fig. 1. Basal cell carcinoma of the skin. Note the variation of cell type. Low malignancy, moderate radiosensitivity.

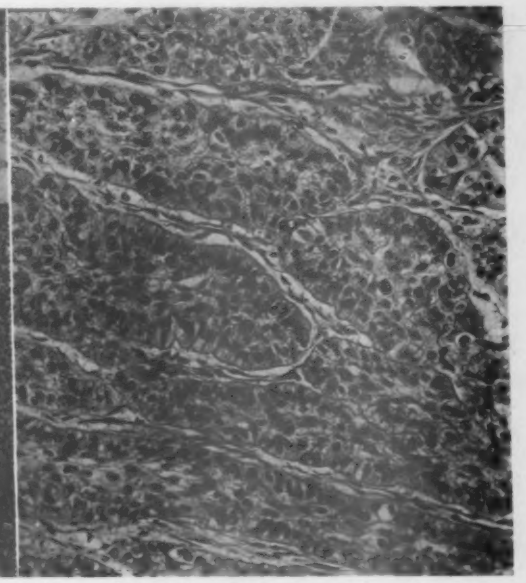

Fig. 2. Adenoid epithelioma of the skin. Low malignancy, moderate radiosensitivity.

The origin of the tumor cells, which determines their physical and physiological characters, is the most fundamental general factor in radiosensitivity. It is of much interest to note that the results of radiotherapy in several fields, by revealing unexpected variations in sensitivity, have led to the more careful study of histogenesis of tumors, and brought to light the existence of new varieties, previously unsuspected. We are thus required to reopen the question of the histogenesis of many epidermoid carcinomas with the hope of explaining their peculiar behavior.

Does an embryonal origin account for the sensitivity of any epidermoid carcinomas? It is difficult to find definite proof of the embryonal origin of any common epidermoid carcinomas, but some basal cell growths of the skin probably arise from isolated embryonal cell groups, congenital epidermoids, in the derma (Fig. 1). Most basal cell tumors arise from hair follicles, and have a certain adenoid

quality. The former group should be radiosensitive and the latter comparatively resistant, but I know of no observations to prove this assumption.

Among the basal cell carcinomas are commonly placed a group of tumors of skin and scalp, which exhibit a very definite adenoid, cystic, or glandular character. The tumors are bulky, and the cells large, cuboidal or cylindrical. Very little connective stroma is produced, and the tumors are moderately radiosensitive (Fig. 2).

The derivation of squamous carcinoma from adult squamous cells undoubtedly determines the adult resistant characters of the tumor cells.

An extensive group of epidermoid carcinomas arise from stratified epithelium which does not produce keratin or horny material and is called transitional epithelium. This tissue lines the upper uterine cervical canal, the trachea and portions of the larynx, the nasal passages, and the ducts of many glands opening on mucous surfaces. An extensive group of epidermoid carcinomas develops from such epithelium, and they regularly exhibit considerable sensitivity (Fig. 3).

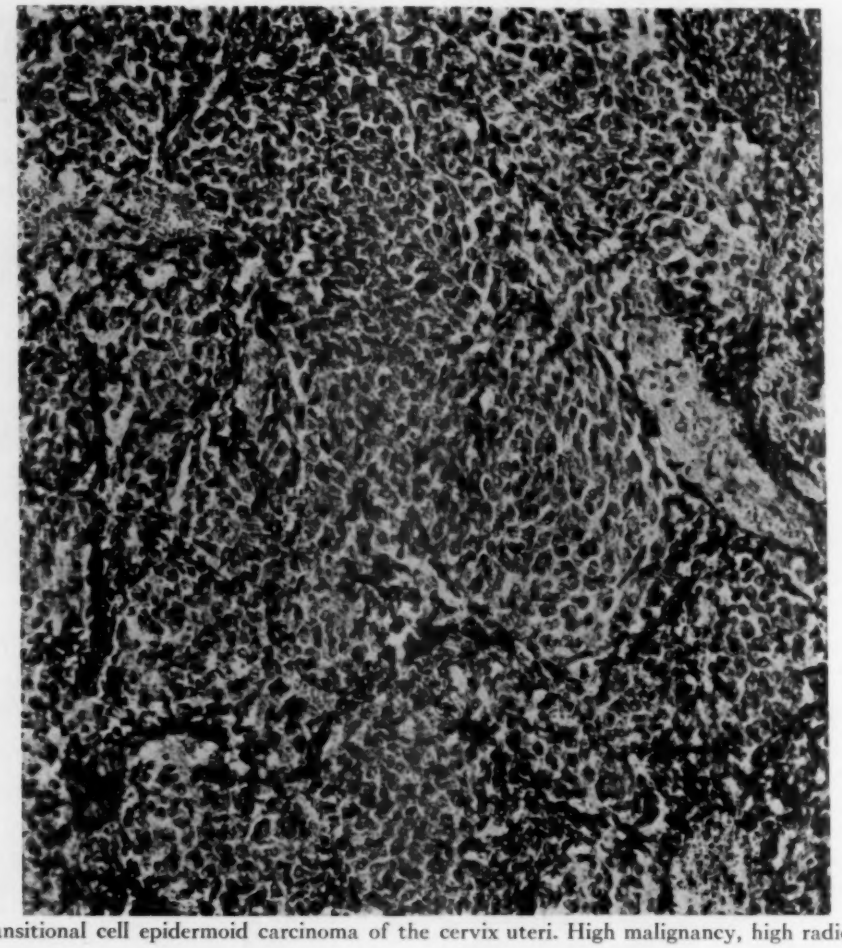

Fig. 3. Transitional cell epidermoid carcinoma of the cervix uteri. High malignancy, high radiosensitivity.

It is, however, often difficult to determine whether a tumor arises from transitional epithelium or from squamous, because metaplasia may yield squamous cells in transitional cell tumors, and squamous tumors may be very anaplastic and fail to produce keratin. In the intraoral group especially, the influence of anaplasia and metaplasia renders the pursuit of histogenesis very uncertain, so

that the influence of this factor on sensitivity cannot well be estimated.

A study of some 300 cases of the intraoral group has led the writer to adopt the following classification, based, with more or less certainty, on histogenesis.

radiosensitivity whether the squamous character is primary or secondary, but the primary squamous tumors are generally more adult and resistant. Anaplastic tumors of squamous epithelium are clinically highly malignant, they lose the

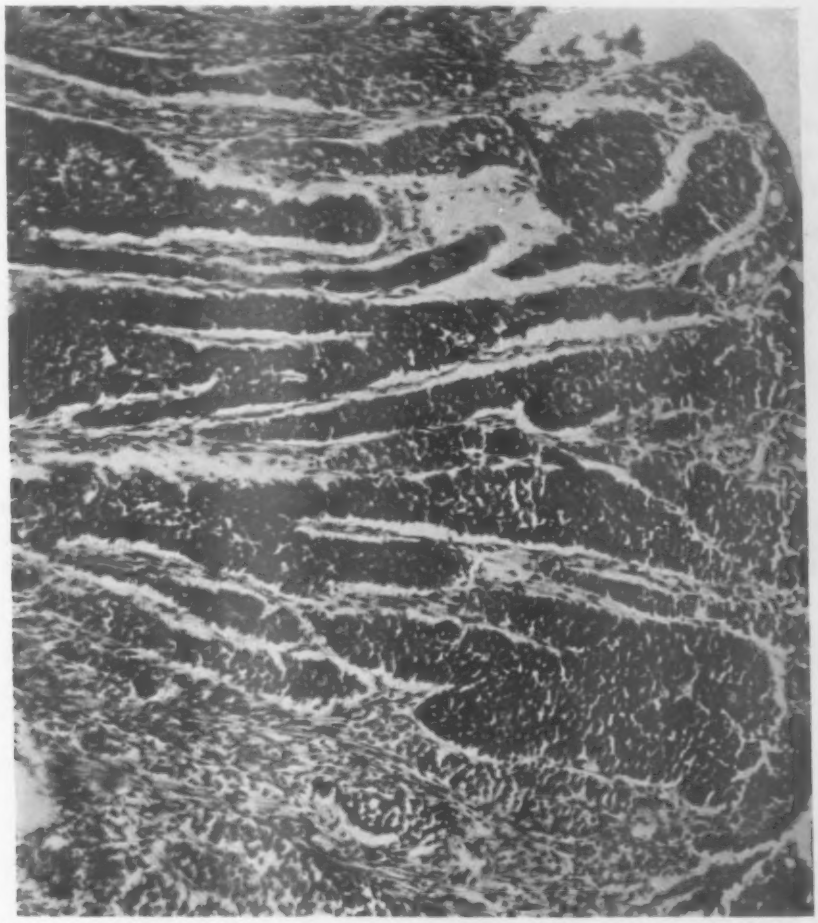

Fig. 4. Epidermoid carcinoma of the esophagus, anaplastic type, high malignancy, high radiosensitivity.

Classification and distribution of intraoral epidermoid carcinomas:

	Tonsil 200 cases	Nasopharynx 100 cases
1. Squamous	72%	30%
2. Transitional	14	37
3. Adenoid cystic	0	4
4. Lymphosarcoma	9	15
5. Lymphoepithelioma	4	11
6. Adenoma malignum	0	3

1. Squamous carcinoma, primary or metaplastic, arises in nearly all regions of the mouth and nasopharynx. It seems to make comparatively little difference in tendency to produce keratin, the sensitivity increases with the rate of growth, but in our experience they generally retain a desmoplastic power, which renders them more resistant than tumors of other types (Fig. 4).

2. Transitional cell carcinoma arises from base of tongue, pyriform sinuses, tonsil, floor of mouth, pharyngeal wall, nasal mucosa and sinuses. There is abundant source of these tumors in areas lined by squamous cells and from the ducts of mucous glands. Many of them begin deep in the

mucosa and these probably spring from the gland ducts, but transitional cell carcinoma may arise from the general stratified layer of cells lining mucous surfaces. They form sheets of rather small cells which are cuboidal or spindle-shaped,

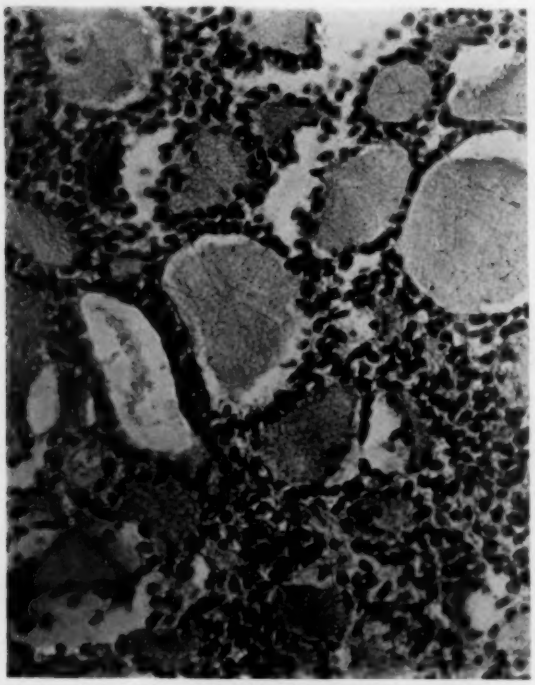

Fig. 5. Adenoid cystic epithelioma of the palate. Low malignancy, high radiosensitivity.

and except in metaplastic areas they fail to produce flat pavement cells or keratin. They excite little growth of connective tissue. For these reasons they are markedly radiosensitive.

The typical structure of transitional cell carcinoma is easily recognized, but the more rapidly growing forms, in which increasing anaplasia may be assumed to exist, I find it very difficult or impossible to separate from some other forms of carcinoma. The location of the primary tumor must be taken into consideration. The majority of uterine cervical carcinomas fall in the transitional cell group, and mainly on this account they are comparatively radiosensitive.

3. Adenoid cystic carcinoma is a term designating a peculiar structure occurring in a group of intraoral carcinomas, which probably indicates a particular origin (Fig. 5). They occur most frequently in the antrum and nares. The cells resemble the basal cell type, but the tumor tissue presents very numerous globules and small cysts filled with mucus. The tumor may resemble thyroid gland. One is probably safe is assuming that they arise from mucous glands, but it is entirely possible that they spring from the lining cells of the mucous surfaces, all of which possess some capacity to produce mucus. They have no desmoplastic property, are very vascular, spontaneous necrosis is common, and radiosensitivity is high. Secondary changes in these tumors give rise to very perplexing pictures often suggesting sarcoma.

4. Much of the nasal mucosa is lined by stratified epithelium with small cuboidal or cylindrical cells forming the Schneiderian membrane. Pathological processes may change the type to ordinary transitional or squamous structures. Several histological varieties of carcinoma therefore take origin in the nasal mucosa, but the typical Schneiderian carcinoma is rather characteristic and is generally recognized as such by rhinologists. The cells are small and cuboidal, they are entirely lacking in pavement qualities, mucus production is not marked and glandular characters are sometimes apparent. Rare tumors of the nasal mucous glands produce the structure of adenoma malignum. A diffuse growth of large cuboidal cells is often encountered and may lead to the diagnosis of lymphosarcoma. Lymphatic metastases to the cervical nodes and blood-borne metastases to the liver and bone marrow frequently occur. The typical Schneiderian carcinomas are highly radiosensitive. They resemble the transitional cell carcinomas and I have classified them as such. It would probably be better to recognize a special group of Schneiderian carcinomas.

5. Lymphoepithelioma. New interest has been added to the subject of nasopharyngeal carcinoma by observations of Regaud and Schmincke on lymphoepithelioma. These authors adopt the theory of Jolly and of Mollier that the epithelium covering the lymphoid deposits of the nasopharynx, especially of the tonsil and base

of tongue, are fundamentally modified by a symbiosis with lymphocytes, and that this tissue should be regarded as a specific organ, lymphoepithelium. Regaud and Schmincke hold that a specific group of tumors arise from this epithelium, and Metastases to the cervical nodes, on one or both sides, are often the first sign of the disease, so that a diagnosis of lymphosarcoma or endothelioma of the nodes may be suggested. The course of the disease is slow, and a fatal issue may be

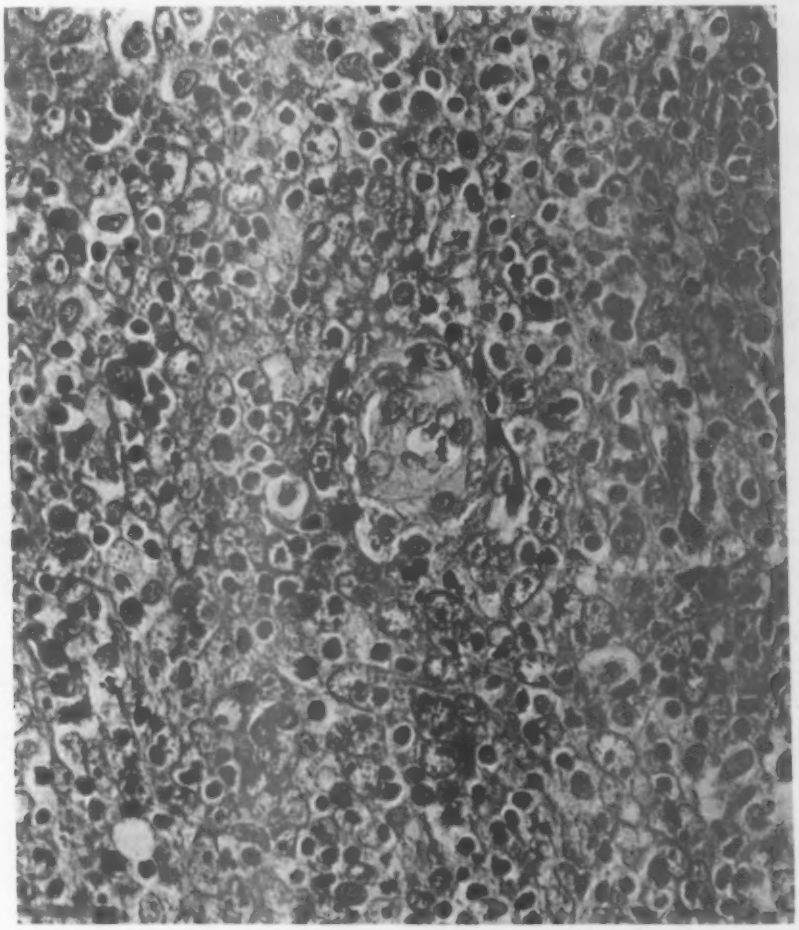

Fig. 6. Lymphoepithelioma of superior nares. Moderate malignancy, high radiosensitivity. Note sheets of large cells uniformly infiltrated with lymphocytes.

that they exhibit a peculiar clinical course, and histological structure. Jovin has recorded a series of these cases. The tumors occur mostly in adults, but we find a similar or identical type of tumor in young subjects, even as early as the fifteenth year. The locations are in the tonsil, base of tongue, recesses of pharynx, and nasal passages. The process causes low polypoid outgrowths, which are slow to ulcerate, or they may begin deeply in the mucosa and no definite tumor may at first be detected. delayed for two or three years. Metastases to the liver and bone marrow are characteristic of the advanced stages, and probably develop early.

The structure is not always the same. Jovin pictures sheets of large delicate cells, with large vesicular nuclei, with indefinite cell borders, infiltrated with lymphocytes (Fig. 6). Schmincke's illustrations show the cell groups more broken up, and the admixture of lymphocytes so abundant that epithelial cells cannot

always be identified, and the process approaches the structure of lymphosarcoma (Fig. 7). Squamous, pavement and spindle cell features are entirely lacking. In the metastases lymphocytes again appear suggesting that they are not merely inwandering cells, but that they may participate in the tumor process. All observers agree that the tumors are highly radiosensitive, but few cases have failed to escape metastases to liver or bone marrow. In the Memorial Hospital a series of 10 cases provisionally classed as lymphoepithelioma or transitional cell carcinoma, have apparently been cured by a combination of irradiation and surgery.

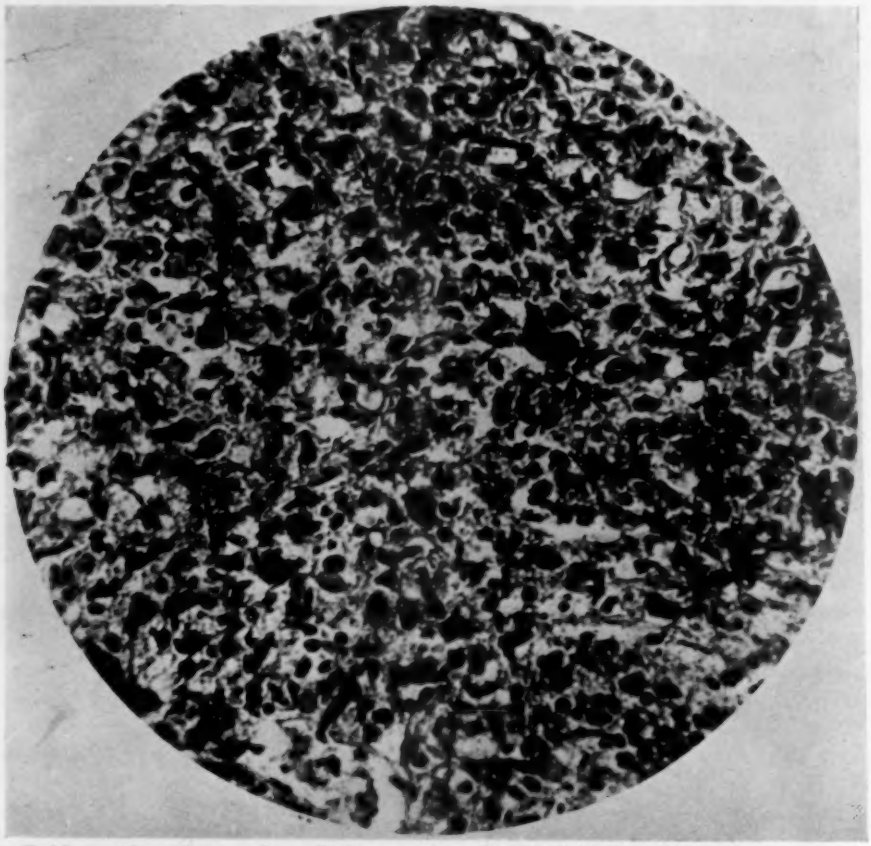

Fig. 7. Epidermoid carcinoma of tonsil. Groups of small epithelial cells infiltrated with lymphocytes.

In the study of our series of 300 tumors of the base of tongue, tonsil and nasopharynx, I have endeavored to identify those which should be classed as lymphoepithelioma, but without complete success. That the epithelium covering the tonsillar crypts of the pharyngeal lymphoid tissue and other nasopharyngeal regions is peculiar in structure owing to lymphoid infiltration must be conceded. That tumors derived from such epithelium should exhibit peculiar characters seems also a reasonable assumption. Yet I have been unable to separate tumors arising in these areas showing the typical structure of lymphoepithelioma, from other tumors which seem to develop more probably from transitional epithelium lining much of the nasopharynx, ducts of glands, and the Schneiderian membrane. The descriptions of Jovin and of Schmincke do not exactly coincide, and the structures they describe certainly apply to some tumors which seem to have no relation to lymphoepithelium. Jovin's descriptions seem to me the more specific. He refers to

broad sheets of large delicate epithelial cells, sometimes forming syncytial masses, and always infiltrated with lymphocytes. I have observed several tumors which presented exactly this characteristic appearance. The structure described by Schmincke is more frequently encountered, but is less specific and appears in many tumors located indifferently in many parts of the nasopharynx, and especially in the nasal passages. There seems to be much evidence in favor of the view that the disordered structure resembling lymphosarcoma described by Schmincke may arise from any mucous surface lined by transitional epithelium, and I have therefore classified them as transitional cell carcinoma.

In the table given above it will be seen that the transitional cell carcinomas are much more numerous, especially in the tonsil, while the lymphoepithelioma of Regaud and Jovin, is less frequent.

Since all these tumors are highly radiosensitive, a distinction cannot be based upon this property. Neither does the occurrence of metastases in liver and bone marrow serve as a criterion since we have observed such metastases with tumors composed of ordinary transitional cells without lymphocytes, with adenoid cystic epithelioma, as well as with other epithelial tumors of tongue, tonsil and nasopharynx. While the existence of a peculiar process properly designated as lymphoepithelioma seems to be fairly well assured, further observations are necessary to determine the scope of this disease and its exact origin.

It is to be noted that the observations on the cellular tumors of the nasopharynx, with their precocious metastases in the cervical nodes removes much, but not all, of the basis for the diagnosis of endothelioma of the cervical lymph nodes.

They do not, however, affect the question of endothelioma of lymph nodes in other parts of the body. Endothelioma of the lymph nodes undoubtedly occurs but it seems to be connected in most cases with a previous granulomatous process in the nodes.

It is also important to point out that the cellular epithelial tumors of the nasopharynx may so closely resemble lymphosarcoma that a differential diagnosis may be impossible without a knowledge of the entire course of the disease.

SUMMARY

Radiotherapy has called for the recognition of several types of epidermoid carcinomas, which were not previously regarded as of much significance.

Radiotherapy receives definite assistance from the systematic grading of epidermoid carcinomas according to the degree of potential malignancy and the degree of radiosensitivity. The two properties generally, but not always, run parallel.

The radiosensitivity of epidermoid carcinomas is referable to many factors, including anaplasia, vascularity, desmoplastic reaction, rate of growth, and especially the tissue of origin.

Radiosensitive epidermoid carcinomas which give poor results with surgery may often be controlled by external irradiation, or by irradiation and surgery and should generally be treated in this manner.

The exact scope of the different types of cellular carcinomas of the nasopharynx, transitional cell, Schneiderian, and lymphoepithelioma has not yet been satisfactorily determined and awaits further investigation.

TREATMENT OF CANCER OF THE LIP AND MOUTH*

BY DOUGLAS QUICK, M.B. (TOR.)

Attending Surgeon, Memorial Hospital

NEW YORK CITY

IN dealing with cancer of the lip and mouth, we have reached the point where surgery and radiation should no longer be balanced one against the other. The treatment of cancer is a strictly surgical problem. Radiation in the treatment of cancer, and particularly the application and introduction of radium, is a technical surgical procedure. I believe we should regard radiation as additional surgical equipment, endeavor to combine it directly with our surgical methods, and possibly alter some of our surgical procedures to meet the suggested needs in this combination.

In no other group of cases is a study of radiosensitivity more essential as a basis for governing treatment than in cancer of the mouth.

We have all been impressed in time past by the varying response of the epidermoid carcinomas to radiation and this variation in response does not cease even within the different groups of this type.

Histological study of material before and after treatment, correlated with the clinical observations, has shown us rather clearly the reasons for this variation in the reaction to radiation. The more adult the type of growth, the more radioresistant it is, and conversely the more embryonal in growth characteristics, the more sensitive it is to radiation. This is exactly opposite to the prognosis from the standpoint of operative surgery alone, and explains why radiation produces better results in the cases most unfavorable from the operative standpoint. This is especially true of those peculiar embryonal types of epidermoid carcinoma which Ewing has termed "transitional cell carcinoma" and of a somewhat limited group to which Regaud has applied the term "lymphoepithelioma."

Within this group there are marked variations in cellular structure, and so it goes on, all the way up the scale to the fully developed adult type of epidermoid, i.e., the squamous cell carcinoma. It was in this group of epidermoid carcinomas that Broders made his original observations and suggested grading into four groups, dependent upon the degree of cellular differentiation.

As the tumors become more undifferentiated, they become more radiosensitive. The practical bearing of this lies in application of the knowledge gained histologically to the governing of the intensity of radiation in a given case. It is obvious, also, that not only the intensity but the combination of the radiation dose, or the combination of radiation with operative surgery, is varied on the same basis.

Before any treatment is considered in a given case, rigid oral hygienic measures should be instituted. Local sepsis not only depletes the patient's general condition and contributes to local necrosis, but it nullifies to a great extent the normal reaction to radiation. In fact, it is very questionable whether radiation ought to be employed in the presence of any marked degree of local mixed infection.

Infected and jagged teeth should be gotten rid of, but it is dangerous to extract teeth at once in the average untreated case. The immediate damage has already been done. Extraction of teeth in the field of active tumor tissue is apt to complicate the problem. The teeth should be dealt with, however, as soon after treatment as the initial subsidence of the radiation reaction will permit.

Since the epidermoid carcinomas embrace a very large percentage of all growths found within the mouth, I am confining my remarks to this group, excluding the few basal cell carcinomas of adenocystic type and the lymphosarcomas. The former represent a local treatment problem, while the latter, from a practical therapeutic standpoint, follow very closely into the group of transitional cell carcinomas. I have seen only one true spindle

* Read at the Twenty-ninth Annual Meeting, American Roentgen Ray Society, Kansas City, Mo., Sept. 25–28, 1928.

cell sarcoma in our entire group of tongue cases.

OUTLINE OF TREATMENT

In the treatment of epidermoid carcinomas of the buccal cavity we have adhered to the same general principles since the beginning of 1917, using external irradiation of maximum intensity consistent with tissue tolerance, and covering both the site of primary lesion and the lymph node bearing areas of the neck. This method is employed in all cases except where, on occasion, variation is indicated in the individual case. The radiation is delivered from both sides of the neck. The neck treatment, however, we shall consider later.

For the more embryonal types of growth, this external irradiation is usually sufficient to produce complete regression. For the squamous cell carcinomas, showing marked cellular differentiation, external irradiation in our experience has not been sufficient to produce complete regression. In these cases we resort to direct implantation of radium emanation or radon in gold capillary seeds having a filtration of 0.3 mm. of gold. Since Failla first produced these filtered emanation seeds in 1924 our results have been immeasurably improved. Beta radiation is eliminated, so that the local reaction is not so severe. Gross necrosis of tissue rarely occurs, even though the amount of gamma radiation utilized is double what was possible formerly when unfiltered emanation seeds were employed. Necrosis of tissue takes place only in the presence of uncontrolled local mixed infection.

The prolonged irradiation extending over a period of a fortnight we regard as clinically superior to the shorter exposure of greater intensity, such as given by the employment of strong radium needles of various types. The principle of gold seed irradiation is more or less comparable to the prolonged irradiation by platinum needles containing a low intensity of radium element, as advocated by Regaud. It has been our experience, however, that the difference in filter is not sufficient to be of practical import, while the range of applicability is greater than with the platinum needles.

In my judgment, surface applicators within the mouth have no place in the treatment of buccal cancer. They may be of value in the treatment of many precancerous lesions, but even this is questionable.

With cancer of the lip, on the other hand, the technical problem is quite different. The lesion can be surrounded on three sides by heavily filtered radium at distances varying up to a centimeter. It is only in the very deeply infiltrating growths of the lip that direct implantation of radon is indicated.

We do not employ operative surgical measures for the direct treatment of the primary growth, in intraoral carcinoma. We do, however, resort to operative surgery secondarily under the following conditions:

1. *For the removal of bone following secondary invasion from growth in the soft tissues.*

I have never seen squamous cell carcinoma secondary in the jaw bones controlled by radiation, except by resorting to the caustic effects of radiation. We consider it better by far to treat the growth in the soft parts by full irradiation, and to follow this through before the maximum effects have become apparent, or immediately after their recession, by surgical removal of the involved bone.

2. *It is at times necessary to provide access to the tumor bearing area by surgical means.*

Particularly is this the case in dealing with growths of the maxillary antrum, especially if the disease has extended into the accessory sinuses or vice versa. On account of the inflammatory reaction occurring in these growths it is usually necessary to provide surgical drainage as well as access.

3. *Cases of bulky fungating character, with infection.*

A certain number of cases of bulky fungating character which always harbor a considerable amount of infection may be cleaned up more quickly and with less discomfort to the patient if the bulk of condemned tissue is removed by surgical means soon after the maximum effects of the irradiation have become apparent. By

increasing the amount of buried emanation to compensate for the amount ultimately wasted, it is at times possible to do this removal a few days after the radon implantation.

Any such variations in procedure may be necessary at times in order to meet the needs of the individual case, particularly if the patient is in poor general physical condition and already suffering from sepsis as well as from the resulting secondary anemia.

It has been our experience that removal of tissue after irradiation, as just described, has been necessitated with relatively greater frequency in tongue cases where growth has developed on the basis of an old luetic leucoplakia or luetic glossitis. These cases have a very poor capillary blood supply with a relative increase in connective tissue throughout the tumor-bearing area, hence they do not afford a satisfactory background for an optimum reaction to irradiation, nor do they withstand the damaging effects of it. In other words, necrosis is very apt to occur.

When it becomes necessary to remove tissue from within the mouth, as just outlined, we employ an ordinary electrothermic cautery, heavily constructed so that it will maintain a uniform degree of heat without intermittent cooling, and with a flat blade which permits of excising the condemned area of tissue, rather than simply burning it out.

We have had experience with the various equipments for coagulation of tissue by means of currents of a high rate of oscillation. These procedures take their place in the cautery field and, whether they or the old-fashioned cautery methods are employed, is a matter of personal preference.

The recent admirable article by Harmer[1] is, in my judgment, the most reasonable presentation of this method to date. I doubt, however, if it quite fulfills all that can be accomplished at present in the treatment of mouth cancer, and I fear that the psychological appeal of such equipment in certain quarters at least, may obscure certain fundamental principles of cancer therapy which are today fairly well recognized.

[1]Harmer, W. D.: Diathermy operations for cancer of the tongue. *Brit. J. Surg.*, 1928, xv, 661–670.

I trust I may be pardoned if I extend the scope of this presentation to include the larynx. Extrinsic laryngeal carcinoma from a surgical standpoint is totally inoperable, and from the radiation standpoint follows on directly from growths at the base of the tongue, and about the epiglottis. That is to say, no essentially new principles are involved.

With intrinsic carcinoma of the larynx, the technical problem is somewhat different. In my judgment, introduction of filtered radium in any form through a laryngoscope to growths below the level of the vocal cords is impracticable. We have, for some time, in these cases resorted to a median laryngotomy, following external irradiation, in order that we might make direct implantation of gold seeds with greater accuracy.

Our experience to date warrants us in endorsing very strongly this method of approach.

TREATMENT OF THE NECK

The treatment of metastases in the cervical lymph nodes is probably of greater importance than that of the primary growth.

Our method of dealing with the neck is based on the premise that the cervical lymph nodes perform a conservative function, up to a certain point at least.

We are all familiar with the protective reactions within the lymph nodes as observed histologically, and further observations on irradiated normal as well as metastatic lymph nodes strongly suggest that this reaction is amplified under the stimulus of radiation.

Whatever may be said of the various glandular types of cancer, it is fairly well established at least, that metastatic extension of epidermoid carcinoma is by embolism.

When a metastatic deposit makes itself evident it is usually in only one lymph node, or at most confined to one or two adjacent nodes. Widespread involvement with multiple nodes involved rarely occurs until very late in the course of the disease. We believe that in the early stages, with a single palpably enlarged node, the capsule of which is intact, the disease can be

dealt with as efficiently as possible by doing a dissection before the capsule becomes invaded. In other words, we do not resort to routine block dissection of the neck. In this plan we make no exception based on the relative location of the primary growth within the mouth.

We treat the neck in each instance by means of heavily filtered external irradiation of maximum intensity consistent with tissue tolerance, and from both sides, as previously mentioned in discussing the primary lesion. For economical reasons, we employ heavily filtered, high voltage roentgen radiation as a routine measure. By preference, we use heavily filtered radium. We are convinced from clinical observations that radium is preferable to roentgen radiation. It is only since we have had at our disposal a 4 gram radium element pack, however, that we have been able to carry out this type of radium irradiation with maximum efficiency, and that only in the more favorable cases. Unless the actual quantity of radium utilized in this manner is equivalent to the quantity of roentgen radiation, then it is preferable to use roentgen radiation. A good dose of roentgen rays is always better than a poor dose of radium.

For some time we were convinced by our clinical observations that roentgen radiation and heavily filtered radium could be combined for the neck irradiation to advantage in two ways. We felt that the total quantity of radiation which the skin would tolerate was greater by combining the two than if a comparable quantity of either agent alone were used. We felt also that the reaction within the tumor-bearing area was superior. Ewing's observations on histological preparations of tissues so irradiated have led him to conclude that the effect of roentgen radiation is more pronounced on the conenctive tissue elements, while radium is more effective on the cellular structure.

Experiments under the direction of Failla in our biophysical laboratories have confirmed our observations on the skin tolerance.

There is a difference dependent apparently on the difference in wave length which permits of increasing the total quantity of radiation by combining the two ranges of wave length.

Patients presenting no palpably enlarged metastatic nodes on admission for treatment, are subjected to heavy external irradiation and kept under routine observation. If a palpable node appears, complete unilateral neck dissection is done under local anesthesia. All the lymph node bearing areas from the chin to the collarbone and including the submaxillary salivary gland, the jugular vein and the sterno-cleidomastoid muscle, are removed through a modified Bastianelli incision. Before the wound is closed, filtered radon seeds are implanted at any suspicious points within the wound, particularly where the lymphatic paths are severed. This does not interfere appreciably with the healing of the wound. No postoperative irradiation is employed.

If the metastatic lymph node is inoperable, we do not resort to an attempted local removal or complete dissection. We take advantage of the surgical exposure to implant filtered radon seeds throughout the tumor-bearing area and close the wound. We prefer this procedure with a minimum of trauma to the blood supply of the local area to a partial removal plus radium for the remainder. We regard any node in which the disease has perforated the capsule of the node, as being inoperable, even though it may be small, and from the standpoint of technique, removable in the gross together with the adjacent structures. We regard all necks with metastatic nodes on both sides as being surgically inoperable from our viewpoint of treatment, even though they may be quite readily removable, technically. Once the disease has involved both sides of the neck, we regard it as incurable by any means, except in very rare instances. For the very advanced metastatic nodes we resort to external irradiation only as a palliative measure.

What I have said relative to neck treatment refers to squamous cell carcinoma. We have not seen complete regression of squamous cell carcinoma, secondary in the nodes, from external irradiation alone.

We are now making physical measure-

ments on a series of cases in an effort to get some idea of the probable amount of radiation in terms of erythema, which may serve as a guide in approximating the probable amount which it may be necessary to employ in order to control this process completely by irradiation.

A typical example of this is one in which a secondary metastatic node appeared two months after irradiation at a point which had received 3.8 erythema doses. This means very little, but a series of such observations and calculations may be of some assistance to us.

Metastatic nodes from an embryonal type of epidermoid carcinoma, even though coming within our definition of an operable node, are treated by radium alone. Occasionally we implant filtered radon tubes as well, just as we do in the treatment of the primary growth in this group, but the backbone of treatment in this type of lesion is external irradiation, and no resort is made to operative surgery for removal.

Our routine external irradiation to the neck is done within a period of a fortnight.

RESULTS

In covering such a large and varied group of cases, it would be obviously impossible to make a complete and detailed analysis from every angle without making the subject burdensome.

This report represents totally unselected cases coming routinely into a radiation service.

In all, 2,741 cases have been observed and treated from December, 1917, to December, 1927. Of these, 49 per cent are now known to be dead; 22 per cent have been lost track of and 28 per cent of the total group of cases are at present in our current active follow-up and their condition noted to June, 1928. Of the entire group, 602 cases, or 21+ per cent are known to be clinically free from gross evidence of disease. Of these, 202 patients have been free from clinical evidence of disease for periods of five to ten years, and 124 cases have been free from clinical evidence of disease for periods of three to five years.

Putting this group of three to ten year cases free from clinical evidence of disease together, we have 326, or 11.8 per cent, of the entire group free from gross evidence of disease for periods *beyond three years.*

One hundred and sixty-five cases are clinically free from disease for periods ranging from one to three years, while 111 cases fall in the group under one year.

It is interesting to note that of the 606 cases lost track of, 202 patients had epithelioma of the lip, and of these, 69 had been followed free from evidence of disease for three years or more prior to their disappearance from observation. It has been our experience that it is more difficult to follow, for a long period of time, cases treated for epithelioma of the lip than any of the other groups of mouth lesions.

The group of cancer of the tongue cases is nearly as large as the group of lip cases, yet only 28 of these cases were lost track of; 9 of them being free from gross evidence of disease three years or more prior to their disappearance.

It is quite evident that the patient who has a lesion on the tongue takes it much more seriously and is ultimately much more co-operative than the lip case; 105 of the total group of 473 tongue cases are now free from clinical evidence of disease; 53 of them being beyond the three year period and 32 beyond the five year period.

The question might very well be asked as to the results of treating the neck as I have outlined.

Taking carcinoma of the tongue as a fairly representative group, and eliminating the cases that have come to us with recurrences, we have a total of exactly 450 cases. Of these, 186 cases came to us without palpable involvement of nodes and remained so throughout their entire course under our care, and 73 of them are now free from clinical evidence of disease; 161 cases had palpable involvement of nodes on admission to the Service. Only 12 of these cases are now clinically free from disease. Of course, relatively few of these cases had operable nodes on admission; 103 cases developed nodes after admission, and of these 16 are now free from gross evidence of disease. This does not mean that the remainder were all lost because of uncon-

trolled metastatic nodes alone. Many of them died because of the advanced character of the primary lesions.

Taking the entire group of 450 cases, we have 101 cases now clinically free from gross evidence of disease. Some few of those regarded as lost were free from evidence of disease when last seen, but of course must be regarded here as failures, since we have not been able to follow them up. I believe that the net percentage in this group of cases, i.e., 22.4 per cent, compares very favorably with the best surgical statistics in operable cases, whereas the group I am reporting covers the routine of good, bad and indifferent cases, as they have come to us. Only 35 per cent of our tongue cases were operable on admission; 50 per cent advanced inoperable; and 15 per cent just beyond operability (based on a radical surgical operability classification).

THE INDICATIONS FOR RADIATION THERAPY IN BENIGN UTERINE HEMORRHAGES*

BY HENRY SCHMITZ, M.D.

CHICAGO, ILLINOIS

THE indication for radiation therapy in benign diseases of the uterus is hemorrhage. Uterine hemorrhages may accompany a great variety of pelvic and extrapelvic diseases. It is evident that the disease and not the symptom "hemorrhage" should be treated. Hence a study of 2,117 consecutive hospital records from the department of gynecology was made: (1) to determine the incidence of uterine hemorrhages; (2) to elucidate the underlying causes and diseases; (3) to show the percentages of the various methods of treatment used, i. e., radiological, surgical or medical, and (4) to discuss the indications for the various methods of treatment.

Uterine hemorrhages have been divided into those dependent upon recent pregnancy, and those independent of recent pregnancy. Hemorrhages resulting from accidents of pregnancy, labor and puerperium and from extragenital diseases are as a rule assigned to the obstetrical and medical departments. However a small number was assigned to the gynecological department and therefore presents a low average in this survey which might lead to erroneous deductions as to frequency.

Accidents of pregnancy, labor and puerperium constitute a large number of uterine hemorrhages. It is imperative that the possibility of such disturbances should always be borne in mind to prevent errors in diagnosis and treatment. If a woman during the child-bearing period of life complains of amenorrhea or of a uterine hemorrhage taking place after a period of amenorrhea or a missed menstrual flow, she should be considered pregnant until proven not to be so. A period of observation will help in the diagnosis. Of the 50 cases listed under metrorrhagia in the column of abortion, 15 had an extrauterine pregnancy, 8 subinvolution, 24 incomplete or threatened abortion, 3 a hydatid mole, and one a chorionepithelioma.

A small number of uterine hemorrhages is caused by acute infectious diseases such as influenza, typhoid fever, scarlatina, variola, rheumatic fever, etc., and chronic organic diseases of the heart, lungs, liver and kidneys, if they produce severe toxemia or general passive hyperemia.

THE FREQUENCY OF UTERINE HEMORRHAGES

A menstruation which lasts too long or is too profuse is termed hypermenorrhea; if it occurs too soon, that is, every twenty-four days or oftener, it is termed polymenorrhea. A uterine hemorrhage varying from a mere "spotting" to very profuse amounts and taking place independent of the menstrual flow is termed

* From the Department of Gynecology of Loyola University School of Medicine, Mercy and Cook County Hospitals. Read at the Thirteenth Annual Meeting, American Radium Society, Minneapolis, Minn., June 11–12, 1928.

metrorrhagia. There must be an aberration from the habitual course of menstruation and it must have been existent for some time in a given instance to place such occurrence in the group of uterine hemorrhages of menstrual type,—collectively also called menorrhagias. However each spotting of blood or unusual bleeding occurring at any period of life calls for an immediate investigation to rule out disease and particularly malignancy. Table 1 gives the total number and percentage of each group of hemorrhages.

TABLE 1

Number of cases admitted	2,117
Number of uterine hemorrhages	802
Per cent of uterine hemorrhages	37.70
In the 802 cases of uterine hemorrhages were observed:	
1. Hypermenorrhea	335 cases, or 41.98 per cent
2. Polymenorrhea	97 cases, or 11.66 per cent
3. Metrorrhagia	
(a) Benign metrorrhagia	117 cases, or 14.66 per cent
(b) Carcinomata	253 cases, or 31.70 per cent

TABLE II

HYPERMENORRHEA

a. Loss of Contractility found in 157 cases, or 47.16 per cent

Disease	Number	Per Cent
Myoma	87	26.13
Hypoplasia	28	8.41
Asthenia	24	7.21
Menopausal bleeding	18	5.41
b. Hyperemia present in 147 cases, or 52.28 per cent		
Infection	131	39.44
Displacement	43	12.94
Not diagnosed	2	0.58

POLYMENORRHEA

a. Primary Ovarian Dysfunctions—35 cases, or 31.11 per cent		
Puberty, before 20 years	19	13.33
Maturity, 20 to 40 years	9	10.00
Menopause, after 40 years	7	7.78
b. Secondary Ovarian Dysfunction—52 cases, or 57.78 per cent		
Infection	43	47.78
Displacement	9	10.00
Not diagnosed	10	11.11

BENIGN METRORRHAGIA

Chronic glandular hyperplasia due to persistent Graafian follicle		
1. Puberty, up to 20 years	2	1.71
2. Maturity, 20 to 40 years	5	4.27
3. Menopause, after 40 years	21	18.77
Total	28	24.75
Menopausal bleeding	7	5.98
Abortions	50	42.73
Senile vaginitis	5	4.27
Infections	17	16.29
Not diagnosed	7	5.98

Hypermenorrhea results from a loss of contractility of the uterus and an active or passive hyperemia. Loss of contractility follows atonicity of the uterine muscle. Myomata interfere with contractility of the myometrium, while hypoplasia and asthenia cause atonicity resulting in weakened contractility. A small number of instances of hypermenorrhea may occur at the ebbing of menstrual life, that is, after forty years, without evidence of myoma, hypoplasia or asthenia. Such hypermenorrheas are probably caused by a uterine asthenia. They are seen more frequently in multiparas with many children than in nulliparas or in women with few children.

Active hyperemia is associated with infectious diseases of uterus and adnexa; and passive hyperemia with displacements, trauma and subsequent scar tissue formation, and with cardiac, renal, hepatic and pulmonary disease causing general passive congestion. In either instance the blood supply to the uterus is abnormally increased, resulting in profuse menstruation.

Polymenorrhea is characterized by shortened periodicity. The menstrual flow may also be too profuse or last too long, that is polymenorrhea may be associated with hypermenorrhea.

The periodicity of the menstrual flow depends upon the time duration of ovulation, which normally occurs within a twenty-eight day cycle. Discrepancies of minus or plus four days are not considered abnormal. Below twenty-four days or less the menstrual periodicity is abnormally shortened and considered a polymenorrhea. In the process of ovulation the ripening of the follicle consumes from fourteen to eighteen days and the life duration of the expelled ripe ovum is ten to fourteen days. One or both of the processes may become shortened and the menstrual onset occur correspondingly earlier. As soon as the ovum perishes, the menstrual decidua becomes detached, menstruation is started, resolution of the corpus luteum ensues and another Graafian follicle begins to mature. Hence polymenorrhea is an outward sign of a disarranged ovarian func-

tion. Such dysfunctions are primary or secondary. Primary ovarian dysfunction is associated with retarded or defective development of the sex organs and with disturbances in the ovarian function at the terminal processes of menstrual life. They therefore occur most frequently at the beginning of menstrual life when the ovary develops to maturity and at the termination of menstrual life when ovarian function begins to ebb.

Secondary ovarian dysfunction is caused by infections invading the ovarian parenchyma, by displacements and trauma causing intense congestion of the ovary, and endocrine disturbances, especially hypofunction of the thyroid and the anterior lobe of the pituitary. The endocrine disturbances are listed as "not diagnosed."

Metrorrhagias are always caused by pathological tissue changes and subsequent loss of continuity of the surface epithelium, by ulceration, necrosis and erosion. Since only benign hemorrhages are to be considered, the malignant diseases have not been placed in Table II.

THE METHODS OF TREATMENT AND THEIR INDICATIONS

From a perusal of Table II, the statement may be made that infections, displacements, traumas and accidents of pregnancy indicate either medical or surgical treatment. Radiation therapy is never indicated in such diseases. Thus 324 benign hemorrhages may be subtracted. This leaves 225 cases for study, distributed as follows:

TABLE III

1. HYPERMENORRHEA

	Total No.	Surgical Treatment	Radiation Therapy	Medical Treatment
Myoma	87	66	15	6
Hypoplasia	28	7	4	17
Asthenia	24	6	4	14
Menopause	18	5	10	3
Total	157	84	33	40

TABLE III.—(*Continued*)

2. POLYMENORRHEA

Puberty	12	3	0	9
Maturity	5	–	2	3
Menopause	16	6	8	2
Total;	33	9	10	14

3. METRORRHAGIA

Puberty	2	1	1	–
Hyperplasia Maturity	5	3	0	2
Hypoplasia Menopause	21	4	16	1
Hypoplasia Menopause	7	4	3	–
Bleeding Total	35	12	20	3
Grand Total	225	105	63	57
Per Cent		46.67	27.11	26.22

There were 87 myomata with bleeding and 15, or 17.25 per cent, were treated with radium. To this number should be added 55 myomata without bleeding, but causing pain, pressure or discomfort. The table then reads as follows:

Total number of myomata	142, or 6.71 per cent of 2,117 cases
Bleeding myomata	87, or 61.27 per cent of 142 cases
Surgery used in	108, or 75.54 per cent of 142 cases
Irradiation used in	15, or 10.79 per cent of 142 cases
Medical treatment or observation	19, or 13.67 per cent of 142 cases

Myomata are new growths and present a different aspect for treatment depending upon the menstrual disturbances due to abnormal functions of uterus and ovaries and benign tissue proliferations. Experience gained by careful observations has taught us to standardize the indications for radium therapy in myoma. These are as follows:

1. No treatment is required in myomata not causing symptoms.
2. Radium treatment is indicated in myomata causing hemorrhages:
   (*a*) If they are free from complicating pelvic infections, especially adnexitis.
   (*b*) If they are not associated with complicating pelvic diseases requiring surgery as ovarian tumors, corpus cancers, etc.
   (*c*) If they are not larger than a four months' pregnancy.
   (*d*) If they are not degenerating.
   (*e*) If they are not growing rapidly.
   (*f*) If they are located intramurally.

(*g*) If they are not complicated with a severe anemia out of proportion to the symptoms and clinical findings.
(*h*) If they are not causing pressure symptoms.
(*i*) If they occur in patients thirty-six years or older.
(*j*) If they do not occur in patients with personal and family neurotic tendencies.
(*k*) If there is no doubt about the diagnosis.

The contraindications, of course, are the direct opposites.

When the indications and contraindications are carefully weighed, then it is not surprising that the percentage of myomata in this series treated with radium is so low.

The conclusion is justified that the treatment of choice in myomata is surgery. Whenever indicated radium should be used as it obviates the dangers of surgery.

Hypoplasia, asthenia and menopausal hypermenorrhea numbered 70 cases. The treatment applied was:

Surgical in.....18 cases, or 25.71 per cent
Radiological in.....18 cases, or 25.71 per cent
Medical in.....34 cases, or 48.58 per cent

The predominant method of treatment in hypermenorrhea due to atonicity and hypoplasia of the uterus was therefore medical; irradiation and surgical methods were used in about 25 per cent for each method. The medical treatment consisted in the use of ergot, hydrastis, pituitary extract from the anterior lobe, adrenalin, regulation of exercise and food to develop and build up the body. If medical treatment failed then dilatation and curettage were employed, and if the latter failed, irradiation was used. However the contraindications to radiation therapy were strictly enforced. They are: (1) co-existing pelvic infections such as adnexitis and pelvic peritonitis; (2) desire for offspring; (3) age, patients thirty-six years or younger, and (4) neuropathic tendencies either personal or familial.

The number of polymenorrheas was 33.

Surgery was used in..... 9 cases, or 27.28 per cent
Irradiation was used in..... 8 cases, or 24.24 per cent
Medical treatment sufficed in16 cases, or 48.48 per cent

The indications for the various methods were the same in polymenorrhea as in hypermenorrhea.

Ovarian dysfunction was combatted by the use of anterior lobe pituitary extract and ovarian follicle extract during the period of supposed maturation of the follicle, and corpus luteum extract during the proliferating and secreting phases of the menstrual cycle. These phases were determined from the history. Frank's method of sexual hormone determination will be a great step forward in correct treatment. If the results of medical treatment were unsatisfactory then dilatation and curettage were performed. If these failed then radium was used, if contraindications did not exist.

The entire number of hypermenorrheas and polymenorrheas, collectively classed as menorrhagias, was 190.

Medical treatment was employed in.....56 cases, or 29.47 per cent
Surgery was indicated in....93 cases, or 48.95 per cent
Irradiation was indicated in 41 cases, or 21.58 per cent

The metrorrhagias, due to benign hemorrhages, numbered 35 cases.

Surgery was used in.....12 cases, or 34.29 per cent
Irradiation was indicated in 20 cases, or 57.14 per cent
Medical treatment was given in..... 3 cases, or 8.57 per cent

Chronic glandular hyperplasia of the endometrium results from a persistent follicle. On bimanual examination the follicle may be palpated as a cyst the size of an English walnut. The menstrual decidua continues to grow. Finally ulceration or necrosis takes place in the uterine mucosa, giving rise to the alarming hemorrhages observed in such cases. There is an absence of menstruation at the expected time, and the hemorrhage occurs within one to three weeks later. To make a diagnosis, curettage and histological examination are essential. Curettage arrests the bleeding in about 50 per cent. Radium is indicated if the hemorrhages recur, if the patient is thirty-six years or older, and if infections and other pelvic diseases do not complicate the hemorrhagic metropathy. The insertion of radium must be preceded by another curettage and microscopical examination to rule out malignant degeneration.

It must be emphasized that a patient suffering from uterine hemorrhages should not be treated unless the underlying cause has been determined and a correct diagnosis made. All uterine bleeding must be viewed with grave suspicion until

proven to be due to benign diseases. If the introduction of the uterine sound into the uterine cavity with strictest asepsis causes a thin stream of bright red blood to escape into the vagina and if the trickling of blood continues for some time after the manipulation, then this observation may be regarded as highly suspicious of malignancy. If an ulcer or erosion on the vaginal portion of the cervix is touched with a cotton applicator and free arterial bleeding ensues, then the ulcer is probably malignant. Such cases should at once be subjected to curettage and diagnostic excision of the erosion or ulcer. The tissues must be examined microscopically to rule out malignant disease.

Finally, every woman suffering from uterine hemorrhage should be examined and, if the cause does not become evident, the uterus should be curetted and the scrapings examined microscopically.

SUMMARY

The number of patients with uterine hemorrhages was 802, or 37.70 per cent, in 2,117 cases admitted to the Department of Gynecology.

The uterine hemorrhages were divided into three groups:

(1) Hypermenorrhea, or profuse and prolonged menses, numbered 335 cases, or 41.98 per cent.

(2) Polymenorrhea, or too frequent menses, numbered 97 cases, or 11.66 per cent.

(3) Metrorrhagia, or uterine hemorrhage occurring without the menstrual period, numbered 370 cases, or 46.36 per cent, which number includes 253 cases or 31.70 per cent, of cancers.

The underlying causes and diseases have been discussed and grouped with the respective numbers and percentages. Those groups indicating medical or surgical treatment or containing the cancers have been deducted as the purpose of the study is the indication for radiation therapy in benign uterine hemorrhages. The number of cases thus remaining is 225.

The methods of treatment employed in each group have been given in numbers and percentages and the indications for radiation treatment discussed.

Medical treatment was curative in..	59 cases, or 26.22 per cent
Surgical treatment was curative in..	105 cases, or 46.67 per cent
Irradiation was indicated in.....	61 cases, or 27.11 per cent

Finally, emphasis has been placed on the necessity of a correct diagnosis before treatment is begun. With a doubtful diagnosis immediate diagnostic curettage or excision of suspicious areas of tissue and microscopic examination must be performed to rule out malignancy.*

* For discussion of this paper see page 341.

A REVIEW OF THE TREATMENT OF UTERINE FIBROIDS, WITH SPECIAL REFERENCE TO THE USE OF RADIUM*

BY WILLIAM NEILL, JR., M.D.

BALTIMORE, MARYLAND

UTERINE fibroids have long been the object of careful study. These tumors possess striking characteristics; with few exceptions they are benign, and may cause no symptoms at all, or produce a multitude of complaints. The presence of malignant changes can be excluded by pelvic palpation, with thorough curettage and microscopical examination. Fibroids are more common after the age of forty but are not unusual during the third decade, and occasionally are met with in younger patients. They tend to produce sterility, and vary in size and rapidity of growth. The large abdominal tumors rarely cause the excessive hemorrhage usually met with in the smaller types. Fibroids are prone to prolong menstruation. There is a tendency for them to cease growing and to decrease in size with the menopause; in rare instances they even disappear. Hyaline changes, with areas of calcification, are not uncommon, and in the larger tumors cystic or abscess formation may be encountered. Sarcomatous degeneration is exceedingly rare and there are no cures by any method of treatment. Malignant changes of the endometrium and cervix are not uncommon but are of no greater frequency than in normal uteri. In a series of 1000 cases at the Johns Hopkins Hospital there were 12 cancers of the body of the uterus and 16 of the cervix. Lateral inflammatory conditions are more frequent in the myomatous than in the normal uteri.

In the beginning abdominal operations for fibroid tumors were all done through errors in diagnosis (Noble). The operation of hysterectomy in reality is credited to McDowell through his discovery and introduction of ovariotomy (1809). The custom in this early time, when the abdomen was opened following a diagnosis of ovarian tumor and the surgeon found instead a fibroid tumor of the uterus, was to abandon the operation because of the belief that such tumors were inoperable. The first surgeon who had the courage to remove a fibroid tumor by abdominal hysterectomy was Charles Clay of Manchester, England, in 1843. The operation in this case was undertaken with a diagnosis of ovarian tumor and when the condition proved to be a uterine fibroid Clay proceeded to do a supravaginal hysterectomy. The patient died of hemorrhage on the sixth day. He performed a second similar operation in 1844, the patient dying of peritonitis on the fifteenth day. It was not until 1863 that Clay did his first successful supravaginal hysteromyomectomy. In Europe the first myomectomy was done by Eddison in 1854. Boinet appears to have been the first continental surgeon to do a hysterectomy in 1852, and with a fatal issue. Koeberle was the first continental surgeon to perform a successful hysterectomy for fibroid (1863).

In America W. L. Atlee performed the first myomectomy in 1844, and John Bellinger in 1846 performed the first hysterectomy which ended fatally. Walter Burnham in 1853 performed the first successful hysterectomy for fibroids of the uterus in this country. All of these operations were done with the mistaken diagnosis of ovarian tumor. It remained for Kimball of Lowell, Mass., in 1853, to perform the first deliberate hysterectomy for fibroid uterus with a correct pre-operative diagnosis. J. Eastman's name is indelibly associated with panhysterectomy, having performed the first operation in 1889. Trenholme of Montreal in 1871, followed in 1872 by Lawson Tait, first advocated the removal of the ovaries as the operation for fibroid tumors, and the operation gained popularity and was still employed on a large scale until the early 80's. It had been observed that these tumors often decreased in size spontane-

* Read at the Thirteenth Annual Meeting, American Radium Society, Minneapolis, Minn., June 11–12, 1928.

ously after the menopause and this led to the practice of producing an artificial menopause through double ovariotomy. Thus the only effective method of treating such tumors from those early days to the past two decades was surgical. Developed with such care and skill through two generations from the days of Burnham, Atlee, Kimball, Stimson, Baer, Keith, Kelly, Price and others down to the present time, the operation in skilled hands has become one of the safest of our major surgical procedures. However, taking an average of all hysterectomies as they are performed, the risk to life and health is still considerable. In any hands there is always the possibility of an embolus, or other untoward sequelae. Even when there is no complication following the operation there still remains the disagreeable hospital experience, and it is rare for the patient to be able to take up her routine duties under six months. This, coupled with the unavoidable indictment that it is after all a mutilating operation, tends to make advisable some better form of treatment. During the past fifteen years radium has been used by the gynecologist in the treatment of fibroids with increasing success, the results of treatment improving *pari passu* with the perfection of technique and selection of cases.

Today we have the choice of one of the following plans: (1) the "let alone and observe;" (2) operation and removal; (3) irradiation. The "let alone and observe" plan, as yet not often recommended by doctors at large, is, I believe, the best in many cases, taking all fibroids as they come to the general practitioner. Where there is no obvious disturbance to health, it is safer to advise the "let alone" plan; the mere fact of the discovery of a tumor is not a sufficient indication for operation, as many believe. This fear of a tumor, or "onkophobia," was generated two decades ago through the literature, piling up statistics and setting forth the numerous complications frequently associated with fibroid tumors. While I do not question these statistics, I do consider the deductions and consequent practices often based upon them largely erroneous. The second choice, "operation and removal," I believe is indicated in the following types: (1) very large tumors, that is, those rising above the umbilicus; here there is always an uncertainty of diagnosis without exploratory incision; (2) large tumors associated with severe pain; (3) tumors accompanied by pelvic inflammatory or any well-defined lateral disease; (4) all tumors accompanied by malignancy of the uterine body; (5) tumors interfering with urinary function by impaction within the pelvis; (6) calcified tumors as suggested by their unusual hardness, and definitely disclosed by the roentgenogram; (7) when there is a reasonable doubt as to the exact nature of the diagnosis, and (8) the definite neurasthenics. Myomectomy is limited in its execution to a single or several definitely isolated tumors. Its mortality rate is higher than hysterectomy and when performed where hemorrhage is a symptom often does not bring relief, and subsequent treatment is required. It does leave a distinct possibility of pregnancy and normal childbirth but this is also possible in fibroids without myomectomy. The third choice, "irradiation," I believe is indicated: (1) in all tumors with hemorrhage, from small myomatous nodules up to freely movable tumors reaching as high as the umbilicus; (2) in selected cases in large tumors rising above the umbilicus (Burnam); (3) in any of the operative classes where the patient is too ill for surgery. Irradiation will accomplish the following: (*a*) control hemorrhage and check menstruation; (*b*) reduce the size of the tumor; (*c*) in the majority of instances cause its complete disappearance; (*d*) occasionally in younger patients permit a return of menstruation. Irradiation from the primary mortality standpoint is a safe procedure. The effect is not definitely understood, but its action apparently is through the ovary and directly on the tumor itself. It is very exceptional for a fibroid to decrease without cessation of menstruation and it is evident from this that in treating fibroids with radium, whether in young or old, a treatment to bring on complete amenorrhea is necessary in order to secure a satisfactory result. An accurate pre-treatment diagnosis is more important when irradiation is con-

sidered than in operation. In every instance an examination under anesthesia, with palpation and diagnostic curettage, should be made. In very large tumors it is difficult to exclude ovarian malignancy, and when there is a history of exceptionally rapid growth it can almost be assumed. Submucous fibroids, presenting at the cervix, should be removed by vaginal myomectomy, and when other tumors are present the same general principles as to operation or irradiation are to be applied. The fact that a tumor is subserous, interstitial, or submucous is of no consequence so far as response to irradiation is concerned. Seventy-five per cent of all fibroids are amenable to radium treatment.

The response of the tumor to irradiation is variable; in some instances the reduction is apparent before amenorrhea is fully established; occasionally a tumor will disappear in six months; in others the reduction is slow, extending over many months or even years after the bleeding has ceased. Intrauterine irradiation produces a more rapid reduction than external irradiation. Approximately 80 per cent of the smaller fibroids and 50 per cent of the larger ones completely disappear.

Technique of Treatment. The uterine cavity is thoroughly explored with the sound, curette and polyp forceps; without the latter instrument curettage is incomplete. The radium, in the form of radon contained in a small brass capsule 1 mm. thick, nested in a second capsule of the same material and thickness and attached to the handle of a uterine sound, is introduced into the uterus. As a rule three capsules of nearly equal strength are applied in tandem, approximating in length the canal above the internal os. An average of 1500 mc-hr. is given at one treatment, the dosage varying to some extent with the size of the tumor. External applications are made over both ovarian regions through the lower abdomen at a distance of 8 cm. from the skin surface, screened with 2 mm. of brass and 1 mm. of lead; an average of from 10 to 12 gm-hr. exposure is given over each area. A combination of the two treatments is rarely necessary. The worst discomforts are nausea and malaise and occasionally uterine cramps. Disagreeable symptoms rarely persist beyond twenty-four hours and only symptomatic remedies are necessary. When hemorrhage has persisted for years there is a tendency to hypofunction of the hematopoietic organs and a resulting secondary anemia. These types require hospital treatment, rest in bed and blood transfusions just as when a hysterectomy is to be done. In the average case treated with radium not more than seven days' rest in bed is necessary.

SUMMARY

This summary is based on 741 fibroid tumors of the uterus treated with radium at the Howard A. Kelly Hospital from April, 1915, to December, 1925. Only definite tumors are included; the benign bleeding cases without demonstrable pathology have been reported elsewhere (Neill). In 91 sufficient final notes were not obtained, leaving 650 on which to base this report. The fibroids varied in size from small myomatous uteri to those filling the pelvis and reaching to and above the umbilicus; 488 of the patients were married, 162 single; average age forty-three, oldest seventy-two and youngest twenty-five. The treatment was by the intrauterine route in 493 and in 157 by external applications. The average intrauterine dose was 1500 mc-hr., varying with the size of the tumor, the smallest dose being 700 and the largest 2400 mc-hr.

The number of menstrual periods following treatment varied from one to four; the majority had one. An immediate cessation was established in over 50 per cent, this result being obtained in 350 out of 634 cases. In 16 a return of normal menstruation occurred without re-growth of the tumor after an interval of from two to five years; one of these has since been delivered of two healthy babies, while another has given spontaneous birth to two healthy babies and one stillbirth at full term.

The most prominent symptom attendant upon the artificial menopause was hot flushes varying from six months to three years; in none was there exceptionally severe vasomotor disturbance, and marked nervous phenomena were entirely absent.

In the vast majority the flushes were less pronounced than those of a normal menopause and this was especially true in the younger patients. These symptoms, however, are often absent or slight and are not uncommon after hysterectomy even when one or both ovaries are preserved. Cullen finds it present in 52 per cent (Kelly and Cullen). Rheumatic pains were complained of in a small number, but in nearly all cases a primary focus of infection could be found as the possible contributory factor. It also happens as one grows older that indefinite aches and pains frequently occur in various parts of the body attributable only to the advance in years. Blood pressure readings before and after treatment did not indicate a definite increase relative to the radium treatment; in fact, any definite change was that of improvement. A tendency to gain in weight was noted, easily controlled by diet. Vaginal discharge accompanied the intrauterine treatments, varying from a few weeks to a year. No other specific features were noted as direct sequelae to the radium. There were no deaths.

It was necessary to give a second treatment in 43 cases, and with this comparatively small number we might well suspect that the full dosage anticipated in some of the earlier patients was not received, due to an inactive emanation tube, which proves the importance of a careful estimation of the strength of each tube prior to treatment. The disappearance or reduction of the tumor may be expected any time within six weeks to ten years. We consider a patient cured when all bleeding and discharge have ceased, when there is an absence of symptoms, and the uterus is normal in size or only moderately enlarged and freely movable, as in the "let alone and observe" type.

Fifty-four hysterectomies were performed at varying intervals following the treatment; in none was the operation made more difficult. Thirty-three hysterectomies were performed within a year at other hospitals, arising from a difference of opinion on the part of the surgeon operating, and 5 died as a direct result of the operation. In 3 cases hysterectomy was done within six months due to an intrauterine slough. In 3 cases hysterectomy was done within a year due to no reduction, accompanied by cystic degeneration. In 10 cases hysterectomy was done due to no reduction and return of hemorrhage. In 2 cases hysterectomy was done elsewhere; one at the time of a gall-bladder operation and the other at the time of an operation for a lateral pelvic inflammatory mass five years after treatment; in both the uterus was found small and atrophic. In 2 cases hysterectomy was done for adenocarcinoma of the uterine body, one developing five years and the other eleven and a half years after treatment; both remained well and free from symptoms in the interim, and I hold no belief that there was any causal relation between the malignant formation and the previous radium treatment. Intrauterine infection occurred in 12 cases, demanding hysterectomy in 3 and pelvic puncture in one, the remainder clearing up promptly after cervical dilatation. No condition tending to shorten life was encountered.

CONCLUSION

While no method of treatment is followed by 100 per cent cures, radium treatment has been effective in a vast majority of cases. Those are excluded from this report which definitely demanded operation, hysterectomy being performed. The fact is also emphasized that if the end-result of radium treatment is not satisfactory, operation has simply been postponed, with an improvement in the meantime in the patient's health.*

REFERENCES

1. Atlee, W. L. *Am. J. M. Sc.*, April, 1846.
2. Bellinger, J. Uterine tumor; removal; death. *Southb. J. M. & Pharm.*, 1847, ii, 244.
3. Boinet. De la gastrotomie dans les cas de tumeurs fibreuses utérines, interstitielles, péri-utérines et dans les tumeurs dites fibro-cystiques. *Gaz. hebd. de méd., Par.*, 1873, x, 117; 198; 298; 369; 447; 461.
4. Burnam, C. F. Report of some observations of effects of radium therapy in cases of large uterine fibroids. *Am. J. Obst. & Gynec.*, 1924, viii, 411–415.
5. Burnham, Walter. The development and present status of hysteromyomectomy for fibromata. *Tr. Am. Gynec. Soc.*, 1897, xxii.

* For discussion of this paper see page 341.

6. Clay, Charles. Observations on ovariotomy, statistical and practical. Also a successful case of entire removal of the uterus and appendages. *Tr. Obst. Soc. Lond.*, 1863, v, 58.
7. Eastman, J. Work in abdominal and pelvic surgery. *Indiana M. J.*, 1889–1890, viii, 219–228.
8. Eddison. See Ref. 14.
9. Kelly, Howard A., and Cullen, Thomas S. Myomata of the Uterus. W. B. Saunders Co., Philadelphia, 1909.
10. Kimball, G. Successful case of extirpation of the uterus. *Boston M. & S. J.*, 1855, May 3, 249.
11. Koeberle, E. Documents pour servir a l'histoire de l'extirpation des tumeurs fibreuses de la matrice par la méthode sus-pubienne. *Gaz. med. de Strassburg*, 1864, xxiv, 17.
12. Neill, W. Jr. Treatment of uncontrollable adolescent bleeding with radium. Am. J. Roentgenol. & Rad. Therapy, 1927, xvii, 461–463. Radium in treatment of menopausal hemorrhage without demonstrable lesion. *J. Am. M. Ass.*, 1927, lxxxviii, 1867–1868.
13. Noble, Charles P. The history of the early operations for fibroid tumors. *Am. J. Obst. & Dis. of Women and Children*, 1899, xl, 171–202.
14. Sloane, John. Gastrotomy; removal of fibrous tumors of the uterus; death. *Brit. M. J.*, 1858, i, 159.

TREATMENT OF HEMORRHAGE FROM THE NON-MALIGNANT UTERUS*

BY O. L. NORSWORTHY, M.D.

HOUSTON, TEXAS

TREATMENT of hemorrhage from the non-malignant uterus has been under discussion for many centuries and not until the introduction of radium into this field by Dr. Abbe of New York in 1905 had any method of treatment equalled that of curettage. It may now be said with assurance that radium can at least produce a temporary cessation of abnormal uterine bleeding in practically all cases in which its use is safe. This should not imply the idea that all cases of uterine hemorrhage should be irradiated, or that radium alone will effect a permanent cure in all cases. It simply means that irradiation will check the hemorrhage and will do so to the benefit of the patient if applied by a gynecologist acquainted with pelvic surgery and one who understands the application of radium and its effects on different tissues.

Organotherapy has been slow in advancement due probably to the handmaidens, biochemistry and physiology; these being of such a nature that much study has been necessary. The gynecologist should study these two sciences in connection with tissue irradiation, and keep in touch with laboratory research of the pathology as to the possibilities of curettage, to meet the indications in all types of uterine hemorrhage. While curettage still has an important place in the treatment of hemorrhage from the non-malignant uterus, its use has been greatly lessened since organotherapy and gamma radiation have been given more careful study.

Hemorrhage from the non-malignant uterus is not confined to any particular race or locality. It has been given much study, yet there is no satisfactory classification of it. In many cases no pathology can be demonstrated. However, as a working basis for an intelligent study of the different methods of treatment, I have adopted the following classification, each group of cases being more or less distinguishable by certain pathological findings:

(1) Adolescent hemorrhage (functional, idiopathic, myopathic, essential hemorrhage).

(2) Bleeding associated with neoplastic growths.

(3) Bleeding associated with inflammatory adnexal diseases.

(4) Pernicious bleeding during gestation.

(5) Menopausal hemorrhage (chronic metritis, fibrosis, climacteric hemorrhage, hemorrhagic myopathica, chronic hyperplasia, arteriosclerosis).

A study has been made of each type of case under the different groups with reference to treatment.

(1) *Adolescent hemorrhage*, at the begin-

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ning of the menstrual function with irregular daily bleeding, if mild, may be corrected by general attention and glandular therapy, ovarian, thyroid or pituitary extracts. The endometrium shows no change until after several months of continuous bleeding. The only possible use for curettage would be removal of the hyperplastic endometrium, which would give relief for only a short time. Radium should not be used until general care, tonics, and glandular medication have failed.

Whether we accept ovarian, myometrial, or endometrial theory regarding the pathology in this type of bleeding, mild irradiation, 100 to 300 mg-hr., from within the uterus will effect a cure in the great majority of cases, in addition to general and glandular medication. Amenorrhea of a few months' duration will be produced followed by normal menstruation, and sex function will be restored. We have had several girls in their teens who had flowed to the point of severe anemia and in whom curettage had been performed before coming for irradiation, who were permanently cured by one mild irradiation. Within a few months menstruation returned and continued normally. We were unable to note any difference in the girls who had been curetted and those who had not.

Adolescent hemorrhage may be studied under four different types: (*a*) epimenorrhea; (*b*) menostaxis; (*c*) menorrhagia, and (*d*) metrorrhagia.

(*a*) *Epimenorrhea* (too frequent menstruation) which is usually the result of too much ovarian action, manifested by a hyperactive state of the sex complex, while troublesome, is not dangerous to life. The ovaries become hyperplastic or polycystic after such a condition has existed for some time, and though the uterine mucosa will hypertrophy after continued bleeding, curettage would be useless. Mild irradiation would relieve both the ovarian and endometrial pathology and at the same time slow up the ovarian action, thereby enabling the entire sex complex to regain its control.

(*b*) *Menostaxis*, the prolonged type, may not occur with every menstruation. Generally there is a history of several prolonged irregular periods. There is an absence of blood clots from the vagina, but in very much prolonged cases many particles of thickened endometrium are passed. While this type of bleeding is likely due to disturbance of the corpus luteum, these patients may be given temporary relief by removal of the uterine mucosa with a curette. Irradiation through the uterus, however, promises greater assurance of permanent relief.

(*c*) *Menorrhagia*, severe menstrual flooding, has a very different pathology to that of menostaxis. Menorrhagia may be compared with the inertia type of postpartum hemorrhage, and is essentially due to "uterine insufficiency." Uterine insufficiency may be the result of many factors affecting both the metra and endometrium. It may be associated with chronic subinvolution or chronic metritis. Approach of adolescence, and also of senility is, at times, associated with "uterine insufficiency." Menorrhagia is infinitely more serious than menostaxis, and if the cause is not removed a severe secondary anemia is soon produced. Associated with the profuse flow of blood are large clots, which may cause considerable apprehension on the part of the patient.

Menorrhagia from a uterus smaller than normal, "infantile uterus," is probably due to undeveloped musculature of the uterine wall. This type of case is usually found in unmarried women, many of whom are relieved by marriage. Pregnancy carried to full term is the most satisfactory method of treatment in this type of case. Curettage will give temporary relief in some cases of long standing. Mild irradiation will effect an easier temporary relief and should be given the preference. Irradiation not to exceed 200 mg-hr. is safe; similar doses to be repeated, if needed. One often sees young women who have had hemorrhages for months from an infantile uterus, in whom pregnancy occurred after curettage or irradiation, and who after a normal delivery remained well.

Menorrhagia from a normal sized uterus is difficult to diagnose. No abnormality, other than flooding, is demonstrable. Blood dyscrasia, or constitutional disease, is

often the underlying cause of such a hemorrhage. A careful search should be made for the cause before treatment is given, if at all safe. Curettage is useless in this type of case. Mild irradiation is safe and will give temporary relief.

Menorrhagia from an enlarged uterus, in adolescent life, is easier of diagnosis. When not due to infection, it is likely due to simple hypertrophic endometritis. In the absence of infection, thorough curettement followed by several weeks in bed, with general care as to diet and elimination, will give splendid results in such a case. Mild irradiation following curettage will insure a more rapid return of the uterus to normal. These women having lost considerable blood, and presenting very much enlarged uteri, are decidedly in need of rest in bed and this should not be overlooked.

Menorrhagia from an enlarged fibrous uterus, even in the young woman, when found to be the result of infection, will respond completely to no treatment other than removal of the uterus. The possibility of endocrine disturbance should be kept in mind in treating all cases of adolescent hemorrhage. This same precaution should be observed in the menopausal group. It is our practice to make metabolic readings in all cases in which glandular disturbance is suspected. Especially do we make metabolic readings in cases of young women of excessive weight, and also in the majority of menopausal cases.

It must not be forgotten that radium is a dangerous agent when used in or around the pelvis of young women. It should be used in girls or young women only in small doses, and not until other simpler remedies have failed.

(*d*) *Metrorrhagia* is generally associated with demonstrable pathology and has a definable and understandable pathology. Its treatment, therefore, is also definable and will not enter into this discussion.

(2) *Bleeding Associated with Neoplasms.* The tumor often found as the cause of hemorrhage from the non-malignant uterus is a myoma. Myomata have a varied consistency from that of calcification to that of a gelatinous mucus. Calcifying growths are responsive only to operative removal. Tumors of gelatinous viscous mucus would likely recur after operative removal, but not so after thorough irradiation, while the soft fig-like tumor would disappear without fear of recurrence after removal or irradiation.

The smooth evenly enlarged uterus with neoplastic growths furnishes the most ideal case for irradiation. It is in this type of uterus, however, that malignancy should be eliminated before discharging the patient. The intramural growths are generally of medium consistency and are so located that homogeneous irradiation is more nearly accomplished.

Routine irradiation is contraindicated in submucous fibroids. These tumors frequently cause alarming hemorrhage. Due to their location, at times projecting into the vagina, the mass becomes infected and the patient is then in a serious condition. Supportive treatment in general, and such surgical removal as the patient's condition will permit should follow. Irradiation should be resorted to only for checking the bleeding, and if called for, should be handled with extreme care. Intrauterine application of radium in the presence of submucous fibroids can be made in safety, and with good effect in selected cases, if introduced under surgical asepsis, and with extreme gentleness, provided the radium is not permitted to remain in place until necrosis has been produced. Operative removal, however, should be the treatment of choice. Patients experience a much longer period of convalescence following irradiation in submucous than in intramural fibroids. This is due to a prolonged watery discharge, which at times is profuse and annoying.

Calcified tumors and subserous fibroids seldom cause excessive hemorrhage from the uterus. Neither of them, due to their location and consistency, are responsive to irradiation.

Retention cysts are very seldom diagnosed, and hemorrhage is not given as a prominent symptom of their existence. We have not encountered this type of tumor in our work; therefore, we cannot speak of it intelligently.

It will be seen that many cases of excessive uterine hemorrhage associated with

neoplastic growths are amenable to irradiation to some degree, though an abdominal operation might necessarily follow in some cases. In the presence of large tumors when hemorrhage has lowered the patient's resistance, the hemorrhage can be checked by irradiation, and the patient will improve and become a fair surgical risk. In cases of extremely large neoplasms, with constitutional or other complications preventing uterine manipulations and operative procedure, the roentgen ray is a most valuable adjunct. The tumor can be very materially reduced by surface application of either roentgen rays or radium. Later radium applied within the uterus will give remarkable and gratifying results. In cases of neoplastic growths where doubt exists as to diagnosis, surgery is to be preferred unless constitutional disease renders the patient a hazardous risk.

Clinics in the larger cities, especially where the negro race predominates, show a much smaller percentage of cases of uterine tumors adaptable to radium treatment than private clinics in which a more intelligent class constitute the majority of patients. In smaller clinics where the patients are predominantly white women, inflammatory and large tumor complications are fewer, and irradiation is practised oftener. The clinic of Clark and associates, in the University Hospital of Philadelphia, and that of Miller of New Orleans, have given the percentage of cases for irradiation as from 33 to 36. In the percentage of cases suitable for safe irradiation in our clinic in Houston, where practically all are private cases and white women, the figures are reversed. We found in a series of cases that 66 per cent were safe for irradiation, and 33 per cent were not.

Uterine tumors in women under forty years of age should be treated by myomectomy or hysterectomy in the absence of contradictory findings. Radium sufficient to cause disappearance of a tumor would cause loss of ovarian function.

(3) *Bleeding associated with adnexal disease* should be studied with the expectation that a surgical operation is the safest treatment, though irradiation may be necessary to check an alarming hemorrhage. It should never be used in such a condition without great hesitancy. The possibility of infection should be eliminated before irradiation. I know of no more serious error than to make an intrauterine application of radium in the presence of any type of pelvic infection, whether recent or long standing. We have had three cases in which a part of both ovaries had been removed on account of hemorrhage, in which the hemorrhage continued. In each case there was an enlarged tender mass which we believed to be part of an inflamed ovary. After eliminating the possibility of infection, through the patient's present and past history, and through the surgeon who opened the abdomen, we used mild irradiation through the vagina with satisfactory results. The tender mass disappeared and the bleeding ceased in each case.

Uterine hemorrhage, due to tuberculosis or syphilis, or other constitutional disease should be treated from the constitutional standpoint, curettage or irradiation being resorted to only in exceptional cases. The same may be said of cases having hemorrhages caused by organic diseases. The organ involved should receive attention, and only as an adjunct when immediate checking of the hemorrhage is imperative should irradiation be practised. Uterine bleeding in case of chemical poisoning—alcohol, arsenic, lead, phosphorus, etc., would be treated accordingly. Hemorrhage of nervous origin, emotional, vasomotor, etc., will respond to radiation therapy more certainly than to medicinal treatment, or to curettage. Marked anemia, if not complicated, is an indication rather than a contraindication to radium. However, when associated with toxic absorption from a necrotic or degenerated tumor, anemia is then a contraindication to its use.

(4) *Pernicious hemorrhage during gestation* is unaccompanied by definite pathology other than that observed in the blood changes. The spleen and thyroid gland should be irradiated. Intrauterine irradiation should be resorted to only in extreme conditions. Curettage is contraindicated.

(5) *Menopausal hemorrhage* may be grouped under three headings descriptive of the conditions that produce the change: chronic metritis, subinvolution and hypertrophy. The uterus in either condition is found to be larger than normal and is regular in shape. The clinical history of each is characteristic, and a diagnosis as to the group into which each falls is not difficult. The microscopical findings are, as a rule, quite characteristic.

Chronic metritis—uterine fibrosis—a sequel of inflammation, is often the result of infection and most frequently follows the puerperal state. Similar pathology may be found in uteri that have never been pregnant. However, in these cases gonorrheal or other infection has been present at some time. Curettement is useless. Heavy irradiation is dangerous in cases giving a history of infection. Hysterectomy is the safest method of treatment.

A subinvoluted uterus associated with hemorrhage is invariably enlarged and boggy. The endometrium is thick and succulent and bleeds freely. Curettage followed by rest in bed and general attention as to tonics, etc., will effect a cure in the cases not associated with infection. Irradiation following curettage will cause a firmer involution of the uterus in the non-infected cases of long standing. In true menopausal hemorrhage in women whose ovarian function is not of great importance, intrauterine applications of radium might well be considered a specific in the absence of contradictory findings. Only in the cases that have been subinvoluted so long that the endometrium has greatly thickened is curettage of use. The tissues and blood vessels in the uterus, ovaries, and adnexa are undergoing hypertrophic changes and it is the effect on these vessels and tissues that makes radium so beneficial.

Contraindications to full doses of radium in the pelvis in the absence of malignancy:

(1) Cachexia out of proportion to the loss of blood.

(2) History of pelvic infection or other peritoneal infection.

(3) Tumors rapidly increasing in size.

(4) Pedunculated and calcifying tumors.

(5) Submucous tumors which so distort the uterine cavity that easy introduction of a radium applicator in the fundus is prevented.

(6) Age, while an important factor in either extreme, does not contraindicate its use. Radium is a valuable agent in checking hemorrhage in young girls, and elderly women do not react badly to it.

(7) Radiophobia: we have seen no case and have noted but one in the literature, that of Keen of Philadelphia.

The material for this study has been obtained from personal experience in the treatment of 121 cases of benign uterine bleeding. Thirteen cases were of the adolescent group. Each of the 13 cases received one treatment averaging 150 mg-hr. All were cured without other surgical procedure. Seven cases had been curetted before the patients came under our observation.

Fifty-six cases had neoplastic growths which were the cause of bleeding; 24 cases received one treatment averaging 1,054 mg-hr., and 32 cases received two or more treatments averaging 2,250 mg-hr. Fifty-one cases were cured with no recurrence of hemorrhage and the tumors disappeared without other surgical treatment. Five cases had abdominal operations later and 3 of the 5 were preoperatively irradiated.

Five cases were associated with adnexal disease. All 5 had had abdominal operations without relief of hemorrhage or pain. Hemorrhage ceased in all 5 of the cases and the tender mass disappeared completely in 3 of them after irradiation. The other 2 were greatly improved when last heard from. None were of the pernicious bleeding with gestation type.

Forty-eight cases were of the menopausal group; 19 received one treatment averaging 816 mg-hr., and 29 cases received two or more treatments averaging 2,050 mg-hr. Forty-five cases were relieved of hemorrhage without other surgical procedure and 3 cases later had abdominal operations.

In all cases of doubt as to diagnosis a biopsy was made, and if it were possible to do so without endangering the patient's life, she was examined under gas anesthesia.

ABSTRACT OF DISCUSSION ON PAPERS OF DRS. SCHMITZ, NEILL AND NORSWORTHY

Dr. H. H. Bowing, Rochester, Minn. The diagnosis is of the utmost importance. We must be certain that we are dealing with benign hemorrhage. I am most anxious about these cases, to be certain that a condition does not co-exist which is not amenable to the small amount of treatment usually applied. One reference was made to ovarian tumors associated with large pelvic fibromyomas. The radium treatment in such a case was only intended to control the menorrhagia. I cannot help feeling that, just as is the case with the surgeon and the clinician who carefully go over them, we as radiologists must be certain that we can accept the case on the same basis. At the start it is best to call their attention to our findings rather than wait for the development of what is apparently a contraindication to irradiation. I recall one case in which there was some infiltration in the adnexa on the right side and following the treatment pelvic cellulitis developed. The surgeon was called in, and could not help feeling that the radium was responsible for the complication. However, I believed that the condition was potential before the radium was used. Finally, the acute phase subsided and at operation a right ovarian abscess was found.

A few years ago all the stress was laid on the pelvic findings, but today we believe differently and the classification of patients, as mentioned by Dr. Schmitz and the others, will probably furnish a basis for a better understanding of the underlying lesion and the employment of better treatment methods.

In all cases the treatment should be ultra-conservative. The uterine insertion is the accepted method. The surgeon and the clinician as well as the radiotherapist are agreed that in well selected cases irradiation is the best method to use. I have accepted a few cases in which a definite history of old pelvic cellulitis was obtained. The menorrhagia was severe; surgical intervention was deemed inadvisable, but something had to be done. Heavily filtered vaginal applicators supplemented by surface radium packs were applied. In the small number of these patients no complications have occurred.

Little was said about the signs and symptoms of the menopause. As a rule this phase of a woman's life is only partly understood. It has been my policy to elicit some of the usual menopausal complaints at the time of the consultation. It is possible to determine the nervous apprehensive individual as well as the one who is reserved and has had throughout her life a stable nervous system. In the latter type of individual I feel that the menopause state is very mild and as a rule well handled. In the nervous individual the menopause is more severe. I am certain that it is well to explain to these patients what they may expect during the menopause. The majority are very grateful for this instruction. Much can be done to ease their discomforts. It has been my policy to use nerve sedatives rather than any type of organotherapy.

Dr. Leda J. Stacy, Rochester, Minn. I believe that the classification of the cases and the contraindications for the use of radium are now universally stabilized. Dr. Schmitz has reviewed these points for us. His statement that the age of the patient determines the treatment is fundamental.

Dr. Neill spoke of the "letting alone and observing" method. Considering that so many women aged more than forty have fibromyomas, one must necessarily let alone and observe. Not every woman with such a tumor needs operation or treatment. Women are now accepting this and not worrying about the presence of small tumors. They are having the uterus examined every six months or so just as they have their teeth examined. Intelligent patients can be carried on in this manner, particularly those near the menopause. It has been the custom in the Mayo Clinic to perform myomectomy in many of these cases, and if pregnancy occurs the patient comes back for radium after termination of pregnancy.

Dr. Norsworthy and Dr. Neill spoke of treating the submucous fibromyomas successfully. It has been our experience that these patients have come to operation subsequently because of return of the bleeding in many instances and the operation revealed submucous fibromyomas. This makes us feel that the treatment is not so satisfactory for the submucous type. In cases in which the basal metabolic rate is low (not necessarily a true myxedema) the bleeding may cease when the rate is elevated although the anemia may be so marked that treatment to control menorrhagia must be instituted; it is in this group that radium is efficacious. The metabolic rate may be −10 or −12 per cent and yet the case may not be one of frank myxedema. It seemed to me one might reverse Dr. Norsworthy's statements regarding the indication for radium for patients near the menopause or in adolescence. It has seemed to me that for patients near the menopause ovarian function is a great factor, but in this group we can readily give radium and clear up the menorrhagia, while in adolescence the metrorrhagia and menorrhagia are due to

ovarian dysfunction, and by changing about with the various ovarian compounds, one can usually strike on some organic compound that will serve until the menstrual cycle is established. It has been my practice to postpone even light radium treatment until treatment by organic compounds has been tried out. The work which is now being done to isolate an ovarian hormone I think will give a solution for these ovarian dysfunctions.

Dr. Albert Soiland, Los Angeles, Calif. Dr. Bowing touched upon one point which I think is of great importance, and that is overcoming the fear of the patient as to what to expect after she has received radium therapy. In recent years we have evolved the plan of telling our patients something like the following: that this treatment does not unsex them, and that it does not destroy the internal secretion from the ovary or produce bad after effects. We tell them it will not change their normal menopause, and that if they should have a stormy menopause as the result of their usual life, we cannot change it. We have felt that it helps greatly to give them such reassurance.

Dr. J. D. Morgan, Philadelphia, asked why Dr. Neill made such a point of excluding roentgen-ray treatment.

Dr. Henry J. Ullmann, Santa Barbara, Calif., asked Dr. Schmitz why he would not irradiate mental and nervous cases. He was interested because of having seen several such patients at the menopause. Those who could take radium were given that therapy, and those whom the psychiatrist thought would be too much stirred up by an operation were given roentgen therapy. The results were so good that this particular psychiatrist said he would send every such patient of his to have the menopause hastened by irradiation.

In regard to the ovarian extract he used this with a little psychotherapy, telling the patient that the menopause would be less stormy than the normal one. Some years ago Dr. N. Sproat Heany of Chicago stated that he found about 50 per cent of these patients benefited by ovarian extract.

Dr. Ullmann asked whether any of the members had tried irradiation of the hypophysis to prevent hot flashes. Since this work came out in the literature he had tried the procedure experimentally in one case with the consent of the patient, who was being awakened many times during the night by this sensation. She kept track of the hot flashes by dropping a match in a box every time she waked up at night. Then he increased the dose slightly, without her knowledge, and the flashes were much increased, so he decreased the doses again, with resulting relief of symptoms. The benefit, therefore, seemed to be due to a stimulation. She left town about that time, but after six months wrote to say that there had been marked improvement after the irradiation.

Dr. Chas. L. Martin, Dallas, Texas. We recently sent out questionnaires to a series of 130 patients in whom the menopause had been produced asking for a description of the symptoms that occurred. The answers obtained have been helpful in reassuring new patients who fear the change of life because of the many untruthful stories that have been circulated.

Many patients dread increased nervousness and possible insanity. More than 80 per cent of the group answering our questions claimed no change or an improvement in their nervous manifestations. I agree with Dr. Ullmann in what he said relative to the treatment of mental cases. I have had several patients with delayed menopause who suffered from extreme depression and melancholia. The production of the artificial menopause caused a cessation of the mental symptoms and restored the sufferers to a normal mode of living. Our investigation revealed another interesting point that ten of our patients reported that although menstruation ceased promptly after treatment no hot flashes ever occurred.

Dr. C. D. Brooks, Detroit, Mich. I was particularly interested in a statement by Dr. Neill in which he emphasized the point that in certain cases with nodular tumors with hemorrhage radium is used until they become definitely good surgical risks. I think this is undoubtedly a good plan. We feel that these nodular tumors are definitely surgical, but if the patients are not in condition for operation we should tell them that we are giving them the radium treatment only until they get into good surgical condition. I agree with Dr. Stacy that it is very important to make very careful blood counts and repeated tests of metabolic rates. One is not enough. We see many young girls who perhaps come from the country to take up new positions in the city, who do not have enough to eat, or enough sleep and their habits of life are entirely changed, and we feel it is very important before taking up any radium therapy to correct their methods of hygiene.

In some cases of fibroid tumors with menorrhagia it is important to give blood transfusions and get these patients in good condition for the radium therapy. We have felt that the blood transfusion was in many cases just as efficient as radium in getting them into proper condition for surgery.

Dr. Curtis F. Burnam, Baltimore. I have had one little experience that may be of some service. In cases of persistent bleeding in young girls which has resisted ordinary medical

methods, where there is no disturbance in the basal metabolism and no need for glandular extracts, where repeated curettage has failed, I have found in four instances that the condition was due to an infection of the nose and throat. On the removal of infected tonsils and adenoids the patients were promptly cured.

Dr. Schmitz (closing). Regarding the question as to why I do not irradiate the neurasthenic patient, I have had two patients who became frankly insane after treatment with radium for uterine hemorrhage. One was the mother of five children and a very brilliant woman. When she first came to the office on account of her menstrual difficulties I made the remark to my assistants that I disliked to treat her. We first tried to see what we could do to arrest the bleeding, going about it in a very conservative way; we tried medication, which failed, and then tried curettage, which also failed. She has been in an insane asylum for two years. The other patient reacted similarly and this has made me greatly worried in regard to this therapy. On the other hand, we see many patients who are nervous on account of the uterine hemorrhage which produces an anemia and these should improve. We must differentiate between the frankly neurasthenic patient and the nervous patient, and if we do that we will discover the patients with whom we have to be extremely careful. I would not wish to have another experience such as those mentioned.

As to the organic extracts, they should be given hypodermically. The effect of any extract given by mouth is destroyed and if we wish to have any result from endocrine therapy it should not be so given. There is only one exception and that is in using the whole extract of the gland to counteract the menopause symptoms. We may use the glandular extract by mouth and follow by hypodermic administration. This whole therapy is in such an unsatisfactory stage that it is difficult to know just where we stand.

I can recall two cases of malignancy following radiation therapy for benign bleeding. One was curetted and a diagnosis of hyperplasia of the endometrium was made. She was treated for that, but died within nine months with carcinoma. The other patient was treated similarly and returned two years later with sarcoma. These are the only two I recall in our series of 800. We should be extremely conservative in the treatment of these uterine hemorrhages, particularly in the women of the puberty period. We must remember that the aim is to restore the patient to a perfect physiological condition, and only after every conservative means has failed should we resort to radiation therapy. Our high mortality in these cases is due to the fact that so many of them are infected. This is to be expected, for so much of the work comes in connection with the work of the medical schools. At the Cook County Hospital 70 per cent of the cases are infected. In order to treat this material it is evident that the indications for radiation therapy are low.

Dr. Neill, Jr. (closing). Ovarian therapy in my hands has been unsatisfactory. Dr. Stacy spoke of patients with definite isolated myomata desirous of children; here myomectomy alone does not always relieve the bleeding. The question of submucous myomata, of course, should be settled at the time of diagnostic curettage. If polypi are present, they should be removed prior to treatment. Greatest caution should be used in the treatment of younger patients. In a series of approximately 12,000 treated with radium for benign fibroids or bleeding we have only accepted for treatment 30 of twenty-five years or younger. In these, careful examinations were made for any underlying cause, foci of infection were eliminated and prolonged rest, hygiene and medication prescribed. Twelve of these had had from one to four dilatations and curettages and 4, suspension of the uterus without relief. I have not observed any definite change in the menopausal habits and my experience has been that the symptoms are less marked than in the normal.

I purposely excluded roentgen therapy because in the Radium Society I feel that the importance of radium treatment should be emphasized. My results with radium have been far superior to those with roentgen rays. The dosage can be so much more definitely estimated and there is less body exposure to the rays.

My conclusions in regard to nervous patients are just the opposite to those of Dr. Schmitz, and in accord with Dr. Ullmann's. By "neurological" I do not mean persons with definite organic mental disorders but those of a nervous type who come in and ask if the treatment will make them insane or name a long list of impossible complications; these I would rather not accept for radium treatment but advise surgery. However, those with definite mental disease I have found respond well to intrauterine irradiation.

In regard to rheumatic symptoms, in 149 cases of bleeding without demonstrable lesions I did not notice any direct relationship of the treatment to arthritis. I mentioned two patients in whom malignancy developed but hold no relation of this to the irradiation. One developed after five and the other eleven and a half years. A friend in Pennsylvania wrote me

during the past winter that he had treated two patients with roentgen rays who had returned with carcinoma of the body of the uterus after an interval of one and two years.

We give treatment to check bleeding in the nodular fibroids, improving the patients' general health, later subjecting them to operation, if necessary. In the vast majority, however, we find the fibroid so reduced in size, with complete clearing up of all symptoms, that operation is unnecessary.

Dr. Norsworthy (closing). Evidently Dr. Stacy misunderstood me in reference to adolescent hemorrhage. Age is one of the most important factors in the use of radium within the female pelvis. No girl or young woman at the adolescent period should be treated with radium with the expectation of curing a tumor. Sufficient radium to destroy a uterine tumor would produce a permanent menopause. Five of our adolescent cases had been curetted and two had had abdominal openings for correction work. All were relieved after mild irradiation. In cases of adolescent hemorrhage the cervix is quite soft and patulous and the introduction of a 25 mg. tube of 0.5 mm. wall thickness of aluminum is very easily made without an anesthetic. In adolescent hemorrhage we advocate all other accepted treatment first, except that of abdominal surgery, before using radium. These patients cease to bleed and show remarkable improvement in every way and menstruation returns to normal within a few months. In many cases 25 mg. held in the uterus for from four to eight hours will yield a most satisfactory result.

The idea that intrauterine use of radium causes insanity is unfortunate and absurd. A fair example of such a case came under my observation recently: A woman approaching the menopause and with profuse bleeding associated with nervous phenomena was given 800 mg-hr. from within the uterus. Menstruation ceased and the patient improved generally for about six months. At this time both the menstruation and nervous symptoms returned. The uterus was removed. The patient soon lost her mind and died insane within four months. The patient's friends charged the insanity to use of radium and were joined in that opinion by the surgeons who removed the uterus.

As to the glandular extracts, we have tried them all but have discovered no definite results except from the hypodermical use of corpus luteum.

Dr. Schmitz' report of cases of pelvic infection is quite suggestive. We have a series of questions bearing on infection that we are particular to have answered before deciding our treatment. A nurse asks the questions, and then I repeat the questions before applying the treatment. We have had two cases of death following intrauterine application of radium. Both cases had been infected at the time of a criminal abortion, but denied it in giving their histories.

The use of radium in a pelvis containing inflamed or tender masses is dangerous, but in the light of an unquestionable diagnosis, is safe and effective. We had occasion to use radium in three cases of excessive bleeding which had continued after partial removal of the ovaries. The surgeons who did the abdominal work assured us of no infection. The bleeding ceased, the tenderness and masses disappeared.

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THE DETECTION AND ESTIMATION OF RADIUM AND MESOTHORIUM IN LIVING PERSONS. I.

BY HERMAN SCHLUNDT

Professor of Chemistry, University of Missouri

COLUMBIA, MISSOURI

HOWARD H. BARKER AND FREDERICK B. FLINN

United States Radium Corporation

Professor, Institute of Public Health, Columbia University

NEW YORK CITY

INTRODUCTION

THE ionizing power of alpha particles emitted from radioactive substances has become the means of detecting and estimating extremely minute quantities of radium and other radioactive elements. For example, a single alpha particle emitted from radium C produces fully two hundred and twenty thousand (2.2×10^5) pairs of ions along its path in air over its range of nearly 7 centimeters. By means of sensitive electrometers or calibrated electroscopes the very feeble ionization currents resulting from the emission of even a small number of alpha particles may be accurately measured, and made the basis for determining quantitatively the amount of the radioactive substance present in the sample of material under investigation. The finest of assay balances would be taxed to its limit in detecting differences in weight of one microgram, but by means of calibrated electroscopes an experienced operator can determine quantitatively one millionth of a microgram of radium—a micro-microgram, $\mu\mu$gm., or 1×10^{-12} gm.

To make quantitative determinations of such extremely small quantities of radium, the emanation in equilibrium with the radium in the material under analysis is separated, collected, and transferred to the ionization chamber of a calibrated electroscope. From the observed increase in the rate of discharge of the electroscope—generally indicated by the fall of the charged leaf system—these small amounts of radium may be determined.

The problem of establishing the presence of radium in living persons, however, involves some unusual circumstances which practically prohibit the determination of quantities of radium of the order of micro-micrograms. We feel that it is safe to say that at the present time, it is problematical indeed whether or not a quantity of radium amounting to a microgram distributed in the body of a living person can be detected with certainty by any of the ordinary methods employed for measuring small amounts of radium. The reason for this disparity is of course obvious: For the estimation of radium of the order of micro-micrograms, the emanation is separated either by bringing the material in solution or by heating to high temperatures. Since such measures cannot be employed for determining radium in living persons, it is clear that the detection of radium in persons suspected of suffering from "radium poisoning," presents a distinct problem in the measurement of radioactivity. The problem is further complicated by the fact that the radium in cases of "radium poisoning" is contained mainly in and distributed fairly uniformly over the entire bony skeleton. The first series of experiments we have conducted to detect the presence of radium and mesothorium in living persons constitutes Part I of this report. In Part II are presented some theoretical considerations which have a direct bearing on the problem.

PART I. PRACTICAL.

GAMMA-RAY METHOD

In the general run of measurements in radioactivity the gamma-ray method is associated with the rating of commercial samples of radium and mesothorium. The amounts of radium compared are relatively large—being expressed in milligrams.

Hence on first thought one would probably consider the gamma-ray method not at all suited for detecting small quantities of radium of the order of micrograms, but after employing the gamma-ray method for two years alongside of methods involv-

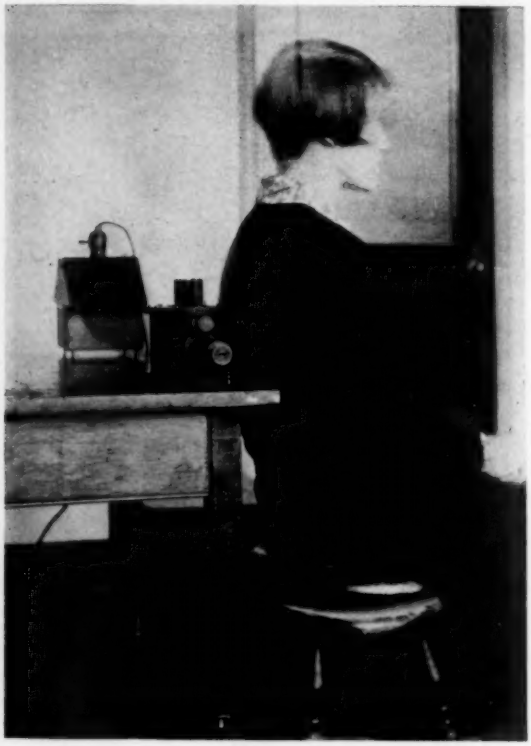

Fig. 1.

ing the measurements of effects produced by alpha rays, we have reached the conclusion that gamma-ray measurements when carefully controlled offer a reliable and rapid method for detecting amounts of radium in living persons as low as 5 micrograms, and in the hands of an experienced operator working under carefully controlled conditions, 2 or 3 micrograms will give a positive test.

After experimenting with several modes of setting up the electroscope with reference to subject under test, the arrangement shown in Figure 1 was adopted. It is seen that the subject is seated in a chair with the back toward the table on which the instrument, a Wulf-Hess quartz fiber electroscope, stands near to the middle of the back of the subject thus assuring close proximity to the bone mass. Before seating the subject a blank test is made which consists in noting the time required for the charged fibers to drift over ten subdivisions of the scale in the eyepiece of the reading microscope firmly attached to the ionization chamber in which are mounted the quartz fibers. This natural drift will vary with weather conditions but as a rule it will take from twenty to forty minutes for one of the fibers to drift over ten subdivisions of the scale. The electroscope is then recharged to the same potential by means of a battery of dry cells or a vulcanite charging rod or more conveniently still, a Zamboni dry pile. The time it takes the fiber to drift over the same ten subdivisions of the scale is then recorded with a stop watch. The patient is then excused and the natural drift of the instrument is taken again over the same ten subdivisions of the scale. The natural drift taken after the test on the subject must be practically identical with the drift taken before the subject was tested. The making of blank tests immediately before and after testing the subject is a sure way of detecting an erratic behavior of the electroscope, which it may be said occurs but rarely when precautions are taken against jarring the instrument in seating the patient.

The following is a typical set of readings:

Natural drift, scale readings 60–50, in	23′–44″	= 0.00702 div. per sec.
Drift, subject under test in chair, 60–50, in	9′–2″	= 0.01845 div. per sec.
Drift, subject under test in chair, 60–50, in	9′–6″	= 0.01831 div. per sec.
Natural drift scale readings 60–50, in	23′–55″	= 0.00697 div. per sec.
Average of natural drifts		= 0.00700 div. per sec.
Average of observed drifts on patient		= 0.01838 div. per sec.
Increase in drift		= 0.01138 div. per sec.

We shall see later that this increase in the rate of discharge of the electroscope represents the presence in the subject of approximately 126 micrograms of radium element.

In Table 1 are given some experimental results obtained by the gamma-ray method covering the range of activities which have come under our observation.

TABLE 1

GAMMA-RAY TESTS—WULF-HESS QUARTZ FIBER ELECTROSCOPE

Subject	Nat. Drift (Av.) Div. per Sec.	Observed Drift Subject	Drift Increase	Approximate Radium Content
A	0.00632	0.01711	0.01080	126
B	0.01128	0.01902	0.00740	90
C	0.00543	0.00576	0.00033	4
D	0.00713	0.00813	0.00100	12
E	0.00582	0.00768	0.00186	22
F	0.00813	0.01063	0.00250	29
G	0.00330	0.00405	0.00075	9

Excepting the first value, 126, the radium content of the subjects, given in the last column of the table, are computed values. The value for Subject A, however, represents an experimental value, and it is through the use of this value that the others were computed. Briefly stated, this basic value was obtained by measuring the drift of the fiber in the Wulf quartz fiber instrument used in the tests with all the subjects, on Subject A a few months before death. After death the radium content of the bony skeleton and body parts was determined by means of an extensive series of radium determinations by the well-known emanation method, which when summed up gave the total radium present in the body of Subject A as 126 micrograms expressed as element. The observed increase in the drift of the gamma-ray electroscope at the time the living subject was under test was found to be 0.0108 division per second, whence per microgram the net drift in the Wulf instrument thus corresponds to 0.0000857 division per second. This value then really becomes the approximate calibration constant of the Wulf-Hess quartz fiber electroscope. The radium content given for each of the other subjects was computed by dividing the observed increase in drift of the fibers by this constant.

The exceedingly small increase observed n the drift of fibers when Subject C was tested is not to be regarded as an accidental effect, for in this case the activity was in part caused by the presence of mesothorium. It will be shown later in the section describing the experiments conducted on detecting radioactivity by the expired air method that far smaller amounts of mesothorium can be detected in the expired air of subjects than radium. In testing the expired air of Subject C, the presence of mesothorium was established with certainty.

At this point we wish to call attention to some special precautions which must be observed in making gamma-ray measurements on persons working in laboratories where radium is being refined or workers handling luminous materials containing radium or mesothorium. The clothes of such persons not infrequently carry traces of radium, and its presence may introduce large errors in the measurements. Before accepting a subject for tests, a thorough cleansing bath is required including a hair shampoo, and a complete outfit of inactive garments must be worn. In one case where a positive test for radioactivity was detected when these precautions had all been observed, it was discovered that the pendant on a necklace worn by the subject was radioactive and that the trace of radium thus carried was entirely responsible for the observed activity.

GAMMA-RAY MEASUREMENTS WITH DIFFERENT TYPES OF ELECTROSCOPES

Our investigations include extensive experiments with several types of electroscopes which all demonstrate conclusively that the observed small increases in drift are directly proportional to the activity of the radioactive source. These experiments were not conducted with active subjects but with normal inactive individuals who carried on their persons small ampules containing standard solutions of radium. In most of the experiments, the small ampules of radium solution were simply placed in the upper vest pockets of the subject under test while gamma-ray measurements were being made with the instrument standing close to the middle of the back as already described. This arrangement leaves the ampules 25 to 30 cm. from the electroscope.

In order to ascertain the adaptability of different types of electroscopes for measurements of this kind comparative experiments were conducted by the pro-

cedure already described. Three instruments were tested: (1) The Wulf-Hess quartz fiber electroscope,[1] whose ionization chamber has a volume of 750 c.c.; (2) a Schmidt aluminum leaf electroscope with ionization chamber of 330 c.c. capacity;[2] and (3) a Lind interchangeable head[3] attached to a large ionization chamber of 3 liter volume. The experimental results are given in condensed form in Table II, in which the first column shows the quantity of radium borne by the normally inactive subject. The other columns give the correspondingly observed increases in drift of the leaf or fiber, and drift per microgram, for each instrument, expressed in divisions per second.

TABLE II

GAMMA-RAY MEASUREMENTS WITH DIFFERENT TYPES OF ELECTROSCOPES

Active Source Micrograms Ra	Wulf-Hess Quartz Fiber		Schmidt		Lind	
	Drift Increase $\times 10^2$	Drift Increase $\times 10^4$ per μgm.	Drift Increase $\times 10^2$	Drift Increase $\times 10^4$ per μgm.	Drift Increase $\times 10^2$	Drift Increase $\times 10^4$ per μgm.
5	0.062	1.24	.....	.....	.....	.....
10	0.199	1.99	.....	.....	.....	.....
20	0.352	1.76	0.172	0.86	0.392	1.96
30	0.608	2.03	0.276	0.92	.....	.....
40	0.814	2.04	0.445 0.448	1.11	0.719	1.80

It will be observed that any one of the instruments can serve for making gamma-ray measurements. For each instrument the observed increase in drift appears to be directly proportional to the activity of the source. Although in the Schmidt instrument the net drift per microgram expressed in divisions per second was found to be only about a half of the value for the other two instruments, its natural drift was so low—five small scale divisions in thirty minutes—and so constant—also a characteristic of the Wulf-Hess quartz fiber instrument—that its adaptability for gamma-ray measurements should not be questioned. The natural drift of the Lind electroscope used was found to be more fluctuating than that of the Wulf-Hess or Schmidt, but in this connection it should be remarked that the weather conditions at the time of most of our measurements were quite unfavorable, thereby accounting for variations in natural drift. It was hot and sultry most of the time. All of the instruments used were fitted with small drying bulb attachments which are indispensable when tests must be conducted on warm, humid days. Keeping the instruments when not in use in a small cabinet provided with large trays containing fused calcium chloride reduces very materially insulation troubles.

Earlier in this report it was stated that per microgram of radium in a living person, distributed fairly uniformly over the entire bony skeleton, the net drift produced in a Wulf-Hess quartz fiber instrument was found to be approximately 0.0000857 (0.857×10^{-4}) division per second. When the radium is concentrated on the breast of the inactive subject, the net drift per microgram, it will be noted, is just about doubled, but more nearly 2.3. Here then we have another relation for estimating approximately, at least, the amount of radium present in living subjects: Measure first the drift increase of the active subject, and then by trial find the number of 5 or 10 microgram ampules of radium solution fastened on the breast of an inactive subject about the same size which will produce the same drift. The quantity of radium in the active subject will be about double the sum of the standard radium solutions. This relation probably holds for any type of electroscope.

To test further the relative sensitiveness of the three types of instruments as exemplified by the net drift per microgram, we measured the drift produced in each by a standard sample of radium. The instruments were paired and readings of drift were made simultaneously, the radium standard of 4.94 milligrams being placed 50 centimeters from the central axis of each instrument. The net drifts thus observed are given in Table III.

The relative drifts of the three instruments stand in practically the same ratios as the drifts per microgram recorded in Table II, and this fact has materially strengthened our confidence in the gamma-ray method for detecting radium in living persons.

The decided difference in the sensitive-

[1] Hess, V. *Phys. Z.*, 1913, xiv, 1135.
[2] Schmidt, *Phys. Z.*, 1905, vi, 561.
[3] Lind, S. C. *J. Ind. Eng. Chem.*, 1915, vii, 406; 1920, xii, 469.

TABLE III
RELATIVE DRIFTS OF DIFFERENT TYPES OF ELECTROSCOPES

Type of Instrument	Net Drift (Divisions per Second)
1. Wulf-Hess quartz fiber	0.409
2. Schmidt	0.213
3. Lind (large chamber)	0.430
4. Lind (small chamber)	0.098

ness of the two Lind electroscopes is due entirely to the difference in volume of the ionization chambers. The same electroscope head was used, but the large chamber had a volume of 3 liters as against 0.5 liter for the small chamber. This result suggests an easy way of increasing the sensitiveness of the ordinary type of electroscope when it is desired to use it as a gamma-ray instrument: enlarge the ionization chamber.

THE EXPIRED-AIR METHOD

Attention has already been called to the extreme sensitiveness of measurements in radioactivity depending upon the ionizing effect of alpha particles. While the limit of detecting radium by the gamma-ray method reaches a few micrograms, the emanation method of determining radium makes possible the identification of amounts of radon of an entirely different order of magnitude. For expressing these quantities we may well choose as our unit the micro-microgram, $\mu\mu$gm., the millionth part of a microgram, or expressed in grams, the unit is, 10^{-12} gm. Paradoxical as it may seem, it is nevertheless true that the tests on expired air as ordinarily conducted are probably not any more sensitive than the gamma-ray method when applied to the detection of radium in living persons. The explanation for this apparent inconsistency lies in the fact that the relatively small volume of air—a liter or two—which the ionization chambers of alpha-ray electroscopes hold, contains at best only that small fraction of the radon which is generated by the radium present in the subject during the time it takes for a few breaths. Per second this amount will be only 2.09×10^{-6} or roughly, 0.000002 of the equilibrium quantity. It is the equilibrium quantity which comes into consideration in stating the sensitiveness of the emanation method of testing for radium. This matter will be explained and illustrated more fully in the theoretical part of this report. At this point, let us call attention to another factor which materially influences the sensitiveness of the expired-air method: Since the free emanating power of radium in the solid state is naturally relatively small, it follows that only a small fraction of the emanation continuously produced by the radium present will find its way into the blood stream and lungs. If for a moment we generously assume that all of the radon continuously produced is exhaled, then none of its transformation products will accumulate in the body, which means that no gamma radiation will be manifest for it is emitted entirely from radium C, which follows radon in the transformation series. Indeed we may go a step farther. The quantity of radium detected by the gamma-ray method of testing is equivalent to the radon which is retained *in situ*, while the quantity of radon which appears in the expired air represents that fraction of the radium which escapes detection by the gamma-ray method of testing. Hence, the total radium present in the living subject is the sum of the values measured by the gamma-ray test and that found in the expired air. In the cases which have come under our observation, the fraction of the emanation produced which finds its way into the expired air did not exceed 3 per cent.*

In the experiments so far conducted we have made no attempt to concentrate the minute traces of radon in expired air of slightly radioactive subjects by condensing it by means of liquid air, or absorption in cooled charcoal.

For the detection of radon in the expired air of a subject we found very serviceable an air-tight ionization chamber of 3 liter capacity fitted with inlet and outlet cocks. The chamber was made to fit a Lind interchangeable electroscope head. The atmospheric air in the instrument was replaced by exhaled air, either

* Subsequently cases have come under our observation in which the free emanating power noted was considerably higher, amounting to as much as 40 per cent of the total radium present.

by having the subject blow air directly through the chamber for a minute or two, or the strong-walled ionization chamber, exhausted beforehand on a good vacuum pump, was filled with expired air which had been collected in a Douglas gas bag. In both methods the expired air before entering the testing chamber was dried and filtered by passing it through two towers filled with coarse calcium chloride (fused) and then through a tube loosely packed with cotton.

Before introducing expired air the natural drift of the instrument must be taken. The electrode system should be kept charged for about twenty minutes before readings are made, and here again readings must always be taken over the same part of the scale. When expired air is tested which has been stored for even a few minutes before it is introduced into the instrument, any observed increase in drift generally indicates the presence of radon, since thoron whose half period of decay is only 54.5 seconds can only be detected in expired air by blowing the air directly into the chamber. In either case readings of the drift taken a few minutes after the introduction of the expired air, assuming that an increase in drift is observed, must not be accepted at once as a positive test for radon for it is well known that dust particles, traces of water vapor condensing on the insulation, or a beam of direct sunlight falling on the charged leaf will change the natural drift. To establish positively the presence of radon in the expired air, readings of the drift should be made at half hour intervals over a period of two to three hours. Unless a distinct increase occurs in the drifts corresponding to the ionization curve of radon, the test is not positive. When radon is present the drifts attain a maximum value in the course of three hours after the introduction of the gas and the maximum for the net drift runs about 30 per cent higher than that found initially, five to ten minutes after the air was introduced. To confirm further the presence of radon, the air in the chamber should be blown out with dry, dust-free atmospheric air, and readings taken of the drift. A distinct drop in the drift occurs when the radon is removed from the chamber. The active deposit left on the walls and electrode of the chamber decays rapidly and in the course of an hour or two the drift of the instrument becomes practically normal.

Mesothorium in living persons can be detected in far smaller amounts by the expired air method than radium, as will be explained in Part II of this report dealing with the underlying principles upon which these measurements are based. Here let it suffice to say that we had no difficulty in establishing the presence of mesothorium in Subject C, whose total gamma-ray activity was scarcely 5 micrograms expressed as radium equivalent. Since this subject had handled considerably more radium than mesothorium it is reasonable to assume that the principal source of the gamma radiation was radium.

To establish the presence of mesothorium (or radiothorium), the expired air is tested for thorium emanation (thoron). The air as it is expired is blown directly into the ionization chamber set up with electroscope head in position. The natural drift having been read, the dried, filtered current of expired air is blown through the chamber for a minute or two. Readings of drift are then taken at once at intervals of 54.5 seconds by two observers. One makes the readings as the other observer holding two stop watches calls off the intervals of 54.5 seconds. When the first reading is being taken the timer starts one of the stop watches; the drift observer makes the second reading at the moment the timer indicates that 54.5 seconds have passed. The timer also stops the watch at 54.5 seconds and starts the other watch at the same time. The reader makes his third reading the instant the timer calls the second period of 54.5 seconds, and starts the other watch off on the third half-value interval, etc. An example of the readings actually recorded by the timer when Subject C was under test is shown in Table IV.

After standing for an hour the natural drift of the instrument with the expired air in it was taken again and found to have returned to normal, 0.060 division per second, the value found before the expired air was introduced. It is seen at a glance

TABLE IV
TEST FOR THORIUM EMANATION

Interval	Scale Readings	Gross Drift Division per Interval	Net Drift per Interval
1	92.0–67.0	25.0	21.7
2	67.0–53.5	13.5	10.2
3	53.5–45.2	8.3	5.0
4	45.2–39.6	5.6	2.3

that the net drifts given in the last column of Table IV identify with certainty the presence of thoron in the expired air whose source is evidently mesothorium. The fact that the natural drift returned to normal after an interval of six minutes and showed no rise in the course of an hour indicates that radium was not detected. We shall point out later that the quantity of radon in the expired air is so small that it may easily escape detection by this method of testing.

The presence of radon in the expired air of Subject B was established by tests made with a large chamber (3 liter) Lind instrument, on three different dates. In one of the tests the expired air was first collected in a Douglas gas bag and a few hours later 2,700 c.c. of it were drawn into the chamber. In the other tests the expired air was forced directly through the drying and filtering trains connected in series with the testing instrument. After the thorium emanation also present had decayed, readings of the drift were taken at half hour intervals for four hours. The net drifts although small showed the normal rise characteristic of radon; and after washing out the chambers with atmospheric air the usual marked drop in drift was observed. In one of these tests the observed drift at maximum, three hours after introduction of expired air was 0.0287 division per second. The initial natural drift was 0.0128 division per second, making the net drift 0.0159 division per second. The average value of the net drifts in the three tests was 0.0128 division per second. Since the calibration constant of the instrument employed in these tests was 7.3×10^{-9}, meaning that 7.3×10^{-9} curies of radon produced a net drift of one division per second, we find the quantity of radon in 2.7 liters of expired air to be:

$0.0128 \times 7.30 \times 10^{-9} = 93 \times 10^{-12}$ curies

This number represents the quantity of radon expired by Subject B in 18 seconds, whence the radon expired per second will be:

$$\frac{93 \times 10^{-12}}{18} = 5.2 \times 10^{-12} \text{ curies}$$

The quantity of radium required to produce 5.2×10^{-12} curies of radon per second is given by

$$\frac{5.2 \times 10^{-12}}{2.09 \times 10^{-6}} = 2.5 \times 10^{-6} \text{ grams} = 2.5$$

The test on Subject B, Table I, indicated an approximate gamma activity of 90 μgm. Hence the total quantity of radium (including mesothorium) was $90 + 2.5 = 92.5$ μgm. The free emanating power of the radium borne by Subject B is given by

$$\frac{2.5}{92.5} = 0.027 = 2.7 \text{ per cent.}$$

By making the same kind of tests on Subject A data were obtained which gave a value of 1.8 per cent for the free emanating power of the radium present.

A comparison of the gamma and alpha ray drifts will now be of determinative significance. In the Wulf-Hess quartz fiber electroscope it was found to be 0.00752 division per second. The net drift of the large chamber Lind instrument averaged 0.0128 division per second. Since the drifts of the two instruments are of the same order of magnitude, the gamma-ray and expired-air methods appear to be on a par for detecting radium in living persons, unless the free emanating power is high, under which conditions the expired air method would be more sensitive; and we recommend that one be used as a check on the other. It should be remarked, however, that the natural drift of the Lind instrument used was generally about four times that of the Wulf-Hess quartz fiber instrument and consequently the factor of error was greater for our Lind instrument. Moreover, the scale divisions in the Wulf-Hess instrument were spaced farther apart than the subdivisions on the Lind. The sensitivity of both types of instruments

could be amplified by increasing still further the size of the ionization chambers. Had we used a Lind instrument with the usual small ionization chamber of half liter volume, the net drift observed by the expired-air method of testing would have been only about 0.0022 division per second, as against 0.0075 for the Wulf-Hess instrument employed for gamma-ray tests. The expired air method, however, offers a very sensitive test for mesothorium or radiothorium.

The experiments which we have conducted on the estimation of radium in excreta, and the detection of radioactivity in expired air by the scintillation method will be reported at an early date in another contribution.

Part II. Theoretical.

Detection of radon electroscopically

The quantity of radium emanation (radon) in equilibrium with one gram radium element, called the curie, has a definite weight and volume. It is one of the fundamental constants in radioactivity. Its volume is 0.663 cubic millimeter, and its weight is 6.5 micrograms. Radon undergoes spontaneous transformation continuously at the rate of 18 per cent per day; or, expressing its transformation constant for the second, we may say that the fraction, 2.09×10^{-6}, is transformed per second. In considering the quantities of radioactive substances concerned in our measurements we have found it helpful to express the amounts in terms of the actual number of atoms concerned. In this statistical analysis of our problem, let us first deduce the number of atoms in one curie of radon. This number may be computed from either its weight or volume and the Avogadro number, 6.06×10^{23}, designating the number of atoms in the gram atomic weight of any element. Applied to radon, atomic weight, 222, it means that 222 grams of radon contain 6.06×10^{23} individual atoms. Hence the *number of atoms* in one curie, 6.5×10^{-6} grams, will be given by the equation:

$$\frac{6.06 \times 10^{23} \times 6.5 \times 10^{-6}}{222} = 1.77 \times 10^{16}$$

This number may also be deduced from radioactive data as follows: The number of alpha particles emitted per second by one gram of radium has been determined experimentally by several investigators, and while the exact value is still in dispute, it will suffice for our purpose to use an average, namely, 3.57×10^{10}. Since the expulsion of an alpha particle from an atom of radium leaves one atom of emanation, it follows that 3.57×10^{10} atoms of radon are continually formed per second per gram radium, and when equilibrium exists the same number of atoms of radon are transformed each second; but in this process of decay only the fraction 2.09×10^{-6} disintegrates per second, whence the total number present must be

$$\frac{3.57 \times 10^{10}}{2.09 \times 10^{-6}} = 1.71 \times 10^{16}$$

another experimental value which checks fairly closely the one deduced from its weight or volume and the Avogadro number.

Let us consider next the number of atoms of radon which were introduced into the ionization chamber of a Lind electroscope whose calibration constant is given as 7×10^{-9} curies. This constant signifies that 7×10^{-9} curies of radon introduced into the electroscope will produce a net drift of the leaf of one division per second when readings are made three hours after the introduction of the radon into the chamber. How many atoms of radon are required to produce this drift of one division per second? The answer is given by the product,

$$1.71 \times 10^{16} \times 7 \times 10^{-9} = 12 \times 10^{7}$$

But only a small fraction, 2.09×10^{-6}, of the atoms of radon undergo transformation per second to produce the ionization measured by the observed drift. Whence the actual number of atoms transformed per second at the time the gas is introduced into the chamber is given by,

$$12 \times 10^{7} \times 2.09 \times 10^{-6} = 253$$

In other words, the net drift of one division per second demands a transformation of approximately 250 atoms of radon per second.

We shall deduce next the drift expected to be observed in a Lind type of emanation electroscope when the ionization chamber contains expired air from a radioactive subject. For illustration let us assume that the living subject carries a deposit of 20 micrograms of radium element. Furthermore we shall generously assume that the ionization chamber used for the measurements is fairly large—of 3 liter capacity. To exhale 3 liters of air will take about twenty seconds. If all the emanation continuously produced by 20 micrograms of radium for a period of twenty seconds were contained in the expired air, how many atoms of radon would then be present in the ionization chamber? It is clear that 20 micrograms of radium produce $20 \times 10^{-6} \times 3.6 \times 10^{10}$ atoms of radon per second, i.e., 7.14×10^{5}, and in twenty seconds, 20 times, or 14.3×10^{6}, which is the number of atoms of radon the expired air in the chamber could possibly contain for it has been assumed that all of the emanation produced finds its way into the expired air. In fact, however, our experiments indicate that not more than 3 per cent is exhaled. But again, generously assuming that 5 per cent of the emanation produced is expired, we find that $14.3 \times 10^{6} \times 0.05 = 7.15 \times 10^{5}$ atoms of radon will be present in the ionization chamber, and of this number, the fraction 2.09×10^{-6} disintegrates per second. Carrying out the multiplication of $7.15 \times 10^{5} \times 2.09 \times 10^{-6}$ we obtain 1.5 for the number of atoms of radon disintegrating per second. As we have shown, a net drift of one division per second of the leaf requires a transformation of approximately 250 atoms of radon per second, including its short-lived products. Hence the expected net drift will be very small indeed, namely,

$$\frac{1.5}{250} = 0.006 \text{ division per second,}$$

a value of the same order of magnitude as the natural drift of the instrument used in our experiments. An increase in drift of this magnitude when identified as produced by radon can safely be made the basis for approximate quantitative determinations. In this connection it should be emphasized that the observed increase in drift will be only one-sixth the above value, or 0.001 division per second when the standard size ionization chamber of 0.5 liter volume is used for testing expired air for the presence of radon.

DETECTION OF RADON—SCINTILLATION METHOD

The lens used in commercial spintharioscopes has a magnification of 7 times, and covers a field of 20 mm. diameter at best. Hence the area of the luminous zinc sulphide screen on which the scintillations can be observed is limited to 3.1 square centimeters. By means of the special mounting and lens which we have employed in our experimental arrangement, a screen area of 6 sq. cm. may come under observation. This screen area will still be slightly less than 2 per cent of the surface area of a cylindrical chamber 8 cm. in diameter and 10 cm. high, whose volume is approximately 500 cubic centimeters. Now the total number of alpha particles expelled per second from the emanation contained in 500 c.c. of expired air exhaled by a subject bearing 20 micrograms of radium will be only 0.25, or in one minute not more than 15 alpha particles will strike the walls of the counting chamber. At best but 2 per cent of the alpha particles will fall on the screen, which is equivalent to saying that one would expect to observe initially a single scintillation at intervals of about three minutes, and after standing three hours, a single scintillation every minute. Since the natural number of scintillations observed by us on samples of commercial phosphorescent zinc sulphide by this method generally ranged from 10 to 40 per minute, it is clear that the experimental error here exceeds the probability deviations from 5 to 10 times. These considerations make us rather skeptical about the reliability of the scintillation method of detecting radon in the expired air of subjects suspected of "radium poisoning."

DETECTION OF THORIUM EMANATION (THORON) IN EXPIRED AIR

In testing the expired air from Subject C, it was established definitely that thoron

was present. The total gamma-ray activity represented about 4 micrograms. With expired air in the 3 liter ionization chamber of the Lind instrument, the initial value of the ionization current observed was actually 30 times greater than the current produced by the radon present in the expired air of Subject B bearing 90 μgm. of radium. Are these experimental results in accord with theoretical expectations? An approximate analysis of one concrete case will answer the question fully. Let us consider a subject bearing 4 micrograms of mesothorium expressed as radium equivalent and measured by the gamma-ray method of evaluating specimens of mesothorium. Let us arbitrarily assume that the mesothorium present has aged two to three years. We may then take, as a first approximation,[1] for the number of alpha particles expelled from the thoron present per gram of mesothorium, a value one-half of 3.6×10^{-10}, the number of alpha particles expelled per second per curie of radon. The number of atoms of thoron continuously produced, equalling, as it does, the number of alpha particles expelled per second by the thoron disintegrating, by 4 μgm. mesothorium will then be given by

$$\tfrac{1}{2} \times 3.6 \times 10^{10} \times 4 \times 10^{-6} = 7.2 \times 10^{4}$$

During 20 seconds, the time required to expire 3 liters of air, the number of atoms of thoron present in the ionization chamber will be at best,

$$20 \times 7.2 \times 10^{4} = 14.4 \times 10^{5}$$

But in the experimental part of this paper we have shown that for radon not more than 5 per cent of the emanation produced finds its way into the expired air. Assuming that the emanating power of thorium X, the parent of thoron is the same as its isotope radium, the parent of radon, it follows that the actual number of atoms of thoron which will be carried into the ionization chamber with the expired air lies in the neighborhood of 7×10^{4}. Of this number, 1.28 per cent are transformed per second, which in this example will be

$$7 \times 10^{4} \times 0.0128 = 900$$

Since the calibration constant of the Lind electroscope used in these experiments had a value 7×10^{-9}, which value we have shown in our statistical analysis to represent the transformation per second of 250 atoms of radon (plus its short-lived active deposit) it follows that the transformation of 900 atoms of thoron (plus Th A) should produce an initial drift of the leaf of about 2.4 divisions per second. Since the observed drift over the initial period of 54.5 seconds in testing Subject C was nearly 0.4 division per second, we see that the observed drift is only about one-sixth of the theoretical value. Now Subject C handles considerably more radium than mesothorium. We would then conclude that the observed gamma-ray activity of 4 μgm. represents the presence of a little less than 1 microgram of mesothorium. We recognize of course that several other factors enter into the problem, but a more precise analysis will not materially affect the conclusions here presented.*

[1] Cf. Schlundt, Mesothorium. Tech. Paper No. 265, United States Bureau of Mines, p. 52.

* The authors wish to express their thanks to Mr. A. L. Miller, who kindly loaned them the use of the Schmidt aluminum leaf electroscope.

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A ROENTGENOLOGIC CONSIDERATION OF ENDOTHELIAL MYELOMA*

BY

B. R. KIRKLIN, M.D. AND HARRY M. WEBER, M.D.

Section on Roentgenology, The Mayo Clinic — Fellow in Roentgenology, The Mayo Foundation

ROCHESTER, MINNESOTA

IT is not without good reason that the diagnosis of endothelial myeloma of bone, or Ewing's tumor, presents considerable difficulty. It is a fairly new arrival into the family of malignant bone diseases, although bone tumors suspected to be of endothelial origin have been described and speculated on since Lücke, in 1866, described a tumor of bone to which he attributed a structure resembling endothelioma; it was not until 1922 that Ewing in a series of studies firmly established this tumor as a definite pathological and clinical entity, and brought our knowledge of it to a stage in which we are able to be on the alert to recognize its incidence. Although this tumor is perhaps more common than the statistics of most men who have studied it would indicate, it still is a relatively rare disease; 67 cases, or about 10 per cent of the total number of cases registered in the Registry of Bone Sarcoma of the American College of Surgeons, are listed as belonging to this type of tumor, and our own study is based on 9 cases out of a total of 78 consecutive cases in which operation was performed for malignant disease of bone, approximately 11.5 per cent. There is still considerable confusion among pathologists concerning the diagnosis of this disease. Not only is the origin and nature of the tumor debated among them, but competent pathologists frequently cannot agree about the same cases submitted for their opinion. This condition obtains as well in other skeletal tumors, and although it is recognized that technical difficulties, such as improper fixing or the section itself failing to be representative of the tumor tissue, might lend a different aspect to a certain case, yet inflammatory disease of bone frequently enters the discussion of the differential microscopic diagnosis. Finally, it is true that only an unusually wide experience in the roentgenologic diagnosis of bone disease will enable one to recognize this disease from the roentgenogram alone, because its resemblance to chronic inflammatory disease of the bone is one of its most constant and characteristic features, and to distinguish it from other neoplastic diseases of bone may at times test the acumen of the most astute and experienced observer.

Among the outstanding characteristics of endothelial myeloma as described by Ewing, Connor, Kolodny, and Sycamore and Holmes, are the following: (1) it involves particularly the long bones, although Ewing calls attention to its frequent occurrence in small bones and flat bones; (2) it usually begins in the middle of the shaft, rarely in the ends, and involves a half or more of the entire bone; (3) it is usually central, rarely cortical; (4) it begins simultaneously in multiple areas which soon coalesce; (5) metastasis occurs most often in the skull and lungs, and (6) in the roentgenologic differential diagnosis, osteogenic sarcoma and chronic osteomyelitis are emphasized as the two conditions most often confounded with endothelial myeloma, although multiple myeloma and metastasis to the bone are mentioned as possible simulants. The cardinal differential points suggested are: Endothelial myeloma attacks the middle of the long bones, widens the shaft and involves more than half of the bone; the favorite seat of osteogenic sarcoma is in the end of the shaft, the growth does not widen but may narrow the bone and it is localized to less than half of the entire shaft. Endothelial myeloma is osteolytic, destroying the cortex in a vertical, linear manner, and new bone, if any, is deposited parallel to the shaft; osteogenic sarcoma

* Read at the Twenty-ninth Annual Meeting, American Roentgen Ray Society, Kansas City, Mo., Sept. 25–28, 1928.

is osteoblastic, destroys the cortex but little and then from side to side, and new bone is deposited usually in radiating spicules perpendicular to the shaft. Endothelial myeloma is multiple, according to Sycamore and Holmes, and osteogenic sarcoma is rarely multiple. According to these authors, there is even destruction of bone in endothelial myeloma which destroys the periosteum without elevating it and there is only slight proliferative reaction; in chronic osteomyelitis the destruction of bone is irregular and the periosteum is elevated intact, these changes being accompanied by extensive proliferative reaction.

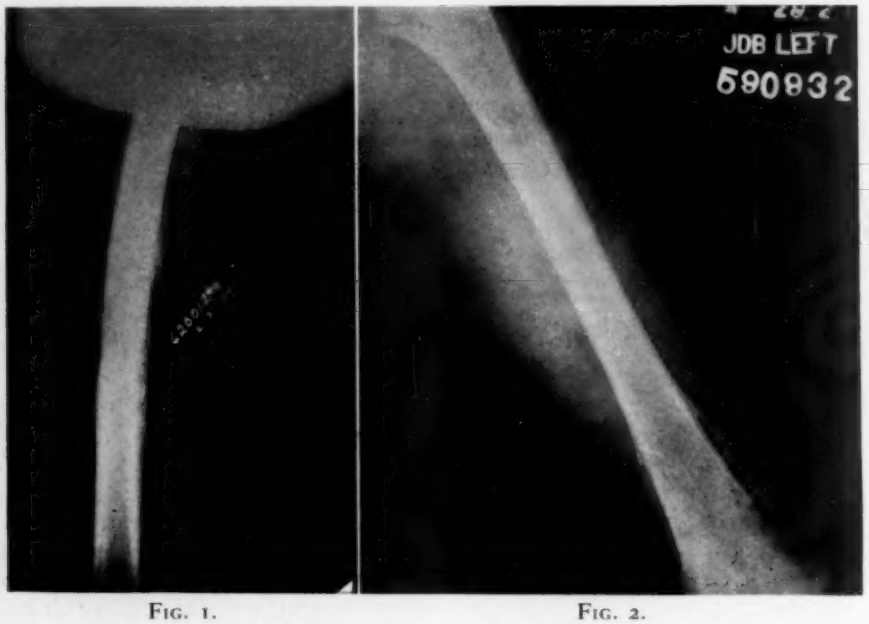

Fig. 1. Fig. 2.

Fig. 1. Lacy veil-like deposit of bone about the area affected.
Fig. 2. Veil-like deposit fringing the affected segment of the bone.

We have observed among 79 consecutive operations for malignant disease of bone in The Mayo Clinic, 6 well-defined cases classified as endothelial myeloma. Three other cases were so atypical as to cause divergence of opinion among clinician, roentgenologist and pathologist, but the balance of diagnostic evidence favored endothelial myeloma and the cases were treated as such; it may be added that the therapeutic test of successful roentgen-ray treatment has since corroborated the diagnosis. Biopsy for diagnostic confirmation was made and radiotherapy was applied in all of the cases. The patients in three of the cases studied have died, one two years after the onset and two within a year after the first symptoms of the disease appeared. All of these had terminal metastasis. It should be understood that this study includes only cases corresponding to those described by Ewing, designated by him as diffuse endothelioma of bone or endothelial myeloma, now almost universally known as "Ewing's tumor." We have not included other neoplastic growths of bone of endothelial origin such as the hemangio-endothelioma or the multiple endotheliomas of bone.

Endothelial myeloma is predominantly a disease of young persons. In our series the oldest patient was twenty-nine and the youngest was two and a half years; the average age was eleven years. Males were affected far more frequently, only one case occurring in a female. Patients were rather uniformly of asthenic habitus, with a delicate build, small bones and slight muscles. A definite relation to chronic dental or tonsillar infection could not be established, nor was there any history of unusually severe attacks of the

infectious diseases of childhood. In only 3 cases was there a history of antecedent trauma, and in none of these could the trauma be definitely linked with the onset of the disease or be assumed to bear an etiologic relationship.

Fig. 3. Evenly distributed area of destruction characteristic of endothelial myeloma.

The bones involved were: the femur in 4 cases, the fibula in 2, the tibia in one case, the humerus in one case and the scapula in one; thus in 8 of the 9 cases the tubular bones were affected. We have not observed the disease in the flat bones of the skull, extremities or vertebrae. In the cases in which the disease occurred in the long tubular bones it seemed to prefer the upper, more proximal portions of the shaft; in only 3 cases showing early involvement did the disease extend below the middle portion of the bone and in only 2 of these did it reach the lower third. In the case in which the scapula was affected almost the entire lower two-thirds was destroyed. In none of our cases was there clinical or roentgenologic evidence of involvement of more than one bone at the time of admission; two years after the first admission, however, metastasis was observed in 2 cases, in one case manifested by widening of the mediastinal shadow which was interpreted as metastatic lymphatic involvement, and in the other by pulmonary and multiple

Fig. 4. Uniform destruction of bone, like that in Figure 3.

metastatic lesions of bone, most prominent in the skull; this appeared as a terminal event in the course of the disease.

Properly to understand the roentgenologic appearance of the disease it is necessary to know something of the life history of the tumor and its method of growth. Characteristically the neoplasm is said to begin in the center of the shaft; as it increases in size it extends up and down the marrow cavity, filling it, and as it expands it approaches and attacks the cortical bone surrounding it, pervading the haversian canals, and spreading out between the lamellae of bone, which are spread apart by the advancing destructive neoplastic growth. This gives the bone the additional increase in thickness which the roentgenogram always shows. Kolodny

recognizes a protective function of the periosteum at this stage, ascribing to it the ability of laying down a reinforcing layer of bone at the periphery of the shaft to resist the rapid aggression of tumor cells. In time this layer, too, is attacked and destroyed. The periosteum continues its almost futile reparative and reinforcing function till finally it is attacked, the tumor perforating through it into the soft tissue. By this time areas of complete destruction of the shaft of the bone are seen and exhibited on the roentgenogram by rarefaction and diffuse dissolution of the cortex. The formation of the so-called onion-like layers of bone surrounding the shaft is frequently observed in this tumor, but we cannot consider the phenomenon characteristic of Ewing's tumor alone since we have observed it in other neoplastic processes and even in inflammatory infections of bone, especially those which we have reason to consider as originating in the medullary portion of the bone, and we are inclined to regard it as a reaction on the part of the periosteum to pressure exerted on it through the cortex by a rapidly growing, advancing intramedullary process.

The roentgenogram is generally conceded to furnish the most significant and reliable data in the diagnosis of the disease. In fact, some authors state that the diagnosis can be made on this evidence alone. In most of our cases we found it more difficult to distinguish the disease from chronic osteomyelitis than from any other single condition, although it has not been confounded at any time with other malignant neoplasms of bone. In the long tubular bones we have invariably observed diffuse absorption of bone involving a variable although considerable portion of the shaft. The destruction of the cortex and the proliferation of tumor tissue within the marrow cavity gives the involved bone a mottled, scarred appearance and it becomes abnormally wide. A few of the cases exhibit a startling, apparently periosteal, reaction; in the soft tissues adjoining the involved portion of the shaft is a

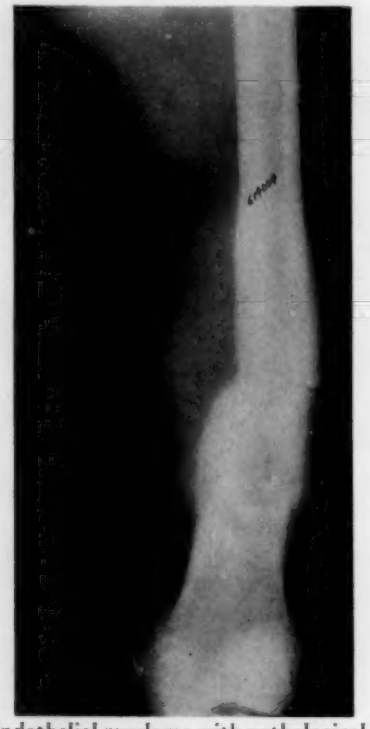

Fig. 5. Endothelial myeloma with pathological fracture. Layered deposit of bone indicative of periosteal reaction.

Fig. 6. Extensive endothelial myeloma of femur with marked widening of shaft and proliferation of bone resembling chronic osteomyelitis.

wide, gauzy structure, its outer margin apparently continuous with the periosteum below. The strands are fairly dense, apparently indicating considerable calcium deposit. This we have interpreted as a reparative phenomenon, in what originally was a liquefied necrotic mass formed by the destructive tumor cells, and now infiltrated with osteoblasts from the periosteum surrounding it; this is a fairly constant observation after irradiation has been instituted. A less marked periosteal reaction in other cases closely resembled periostitis of infectious origin. In the single case occurring in a flat bone, the scapula, the process might easily have been confounded with osteogenic sarcoma. The resemblance was striking in that spicules of bone radiated perpendicularly from the surface of the bone, but the even, diffuse destruction of the entire lower half of the scapula, which seemed to have undergone almost complete dissolution, and the absence of other osteogenic phenomena led to the diagnosis of diffuse endothelioma.

Although other observers have called attention to the difficulty of distinguishing endothelial myeloma from osteogenic sarcoma, we have not encountered a case occurring in the long bones in which osteogenic sarcoma was suspected roentgenologically. It is true that osteogenic sarcoma was suspected in the one case in which the scapula was affected, but we believe that if the tumor is in a long bone there should be little difficulty in ruling out osteogenic sarcoma, since it attacks a limited area in the bone, usually at the end, and produces a definite osteogenic reaction with radiating spicules of bone laid down perpendicular to the shaft; endothelial myeloma usually attacks a larger portion of the shaft, resulting in evenly distributed absorption of bone, and as the tumor grows, definite widening of the shaft.

Osteomyelitis, on the other hand, has some roentgenologic characteristics resembling endothelial myeloma, namely, the shaft is widened, absorption of bone may occur in some cases in a manner closely resembling that of endothelial myeloma, and new bone is occasionally deposited parallel to the shaft but, as mentioned, the reparative process in chronic inflammation of bone is more marked, and the destruction of bone is usually more irregular than in endothelial myeloma. Subperiosteal abscesses are common in osteomyelitis, causing elevation of the periosteum; in endothelial myeloma the periosteum is destroyed early in the course of the disease and is rarely elevated. Occasionally following the operative treatment of chronic osteomyelitis a peripheral network of new bone appears, but it is coarser and less extensive than that incident to Ewing's tumor. Indeed, one of the most constant and striking features in our cases of endothelial myeloma has been the delicate, lacy, veil-like shadow in the soft tissues adjoining the affected area. Although in all cases save one it was not seen until after the institution of radiotherapy, and thus might be regarded chiefly as a reparative phenomenon, it seems to be a characteristic sign of the disease (Figs. 1 to 6).

REFERENCES

1. Connor, C. L. Endothelial myeloma, Ewing. *Arch. Surg.*, 1926, xii, 789–829.
2. Ewing, James. Diffuse endothelioma of bone. *Proc. N. York Path. Soc.*, 1921, xxi, 17–24.
3. Ewing, James. Neoplastic diseases. Third edition. W. B. Saunders Co., Philadelphia, 1928, 1127 pp.
4. Kolodny, A. Bone sarcoma; primary malignant tumors of bone and giant cell tumor. *Surg., Gynec. & Obst.*, 1927, xliv (*suppl.*), 1–214.
5. Lücke, A. Beiträge zur Geschwülstlehre. *Arch. f. path. Anat. u. Phys.*, 1866, xxxv, 524–530.
6. Sycamore, L. K., and Holmes, G. W. Endothelial myeloma. Am. Jour. Roentgenol. & Rad. Therap., 1927, xviii, 223–230.

DISCUSSION

Dr. E. L. Jenkinson, Chicago. I became interested in the so-called Ewing's tumor, some time after Dr. Ewing's original article was published. We felt as Dr. Kirklin does about this, that it was a primary tumor. We still hold that opinion, notwithstanding the attitude of our pathologists, Dr. Lacount and Dr. Hirsch. Some time ago, I think it was a year ago, probably a great many of you recall it, Dr. Ryerson and Dr. Hirsch published an article on so-called endothelial myeloma in the *Annals of Surgery*. I think there were 5 cases in all. I recall 3 of these very distinctly as they had been examined in our roentgen department. We thought they were so-called Ewing's tumor. At that time, of course, the pathologists agreed with him. One of these patients was a boy about eleven years old. He had the typical history

described by Connor—some trauma, low grade temperature, and there had been several diagnoses of osteomyelitis following examination of tissue removed. He was operated on a number of times but at no time was he irradiated. He lived in Arizona, and later died there. Dr. Hirsch went to Arizona and did a complete post mortem. His diagnosis was that the condition was secondary to bronchogenic carcinoma of the lung. In the other 4 cases he also attributed the change as secondary to carcinoma elsewhere in the body. Four of the cases showed carcinoma of the lungs, and one hypernephroma of the kidney.

Dr. Lacount has been very emphatic in his statements. He claims there is no such thing as primary endothelioma, except possibly in the Pacchionian bodies. All these cases he attributes as due to secondary carcinoma. He also said that in the reports of Dr. Kolodny in *Surgery, Gynecology and Obstetrics* on these cases of Ewing's tumor there is a scarcity of complete post mortems. He doubts the value of so-called surgical sections in making diagnoses in these cases. This criticism is also true, according to Dr. Lacount, of Dr. Connor's article. There is all through the article a scarcity of complete post mortems.

Dr. H. K. Pancoast, Philadelphia. Our experience with this tumor is very limited, and I feel rather reticent about discussing it. In both cases of known Ewing's tumor which we have seen, the radius was the bone affected. One other case seen this summer of a tumor in the os calcis is very much like Ewing's tumor, and I think Dr. Ewing has seen several involving the os calcis.

You will all agree from the slides we have seen that it is a tumor which is not easily diagnosed, the diagnosis cannot be made at a glance, but only by careful exclusion of other growths. The appearance is quite different in different stages of the growth, and I believe it is different in different bones, depending to a great extent upon the texture of the bone involved.

One is very easily confused with the diagnosis of sarcoma in the external appearance which you see, particularly that of radiating spicules. This is not characteristic of any particular tumor. It may occur in numerous cases of metastatic carcinoma, sarcoma, Ewing's tumor, and in various other tumors, and also in syphilis, and is simply an appearance which is apt to arise when the periosteum becomes involved by the growth. I am very glad to have seen this very unusual collection of cases. I think we are all encouraged to hear Dr. Kirklin say that the diagnosis is not always possible from the roentgenogram.

Dr. Ralph S. Bromer, Philadelphia. I feel after seeing the group of cases that Dr. Kirklin has shown us that the necessity for differentiation from osteomyelitis is very apparent. The other point is the question of surgical sections. In one case in particular which we had occasion to study, it was diagnosed as osteomyelitis and was sent to a very competent pathologist who returned a diagnosis of chronic inflammatory tissue. Four weeks after, the diagnosis was very apparent, and on study of many additional sections he found the appearance which was seen later at autopsy. Therefore if any dependence is to be put on surgical sections, the entire specimen removed should be sent to the pathologist.

Dr. Kirklin (closing). Recognition of endothelial myeloma as an entity is due solely to the pathologist and I am sure that most of us have accepted Ewing's opinion regarding this matter. I have been very much interested in the discussion of the 4 cases which Dr. Hirsch and Dr. Ryerson reported in the *Annals of Surgery*, and if their conclusions are correct present ideas regarding this disease must be changed. It is rather difficult for me to believe that this condition is a metastatic lesion from bronchogenic carcinoma, as it would seem from my limited experience that it would be more reasonable to assume that the lesion in the lung is metastatic from the primary bone condition. I have had the good fortune to study a fairly large series of cases of primary malignant conditions of the lung which I have reported from time to time, and so far as I have been able to determine there have been only 2 cases in the series seen at the Clinic in which there was metastasis to bone. In neither case did the metastatic area in the bone give a roentgenologic appearance simulating that given by Ewing's tumor. Another interesting point is that all authors agree that primary malignant conditions in the lung occur after the age of thirty, and that the highest number occurs after forty. On the other hand, endothelial myeloma is essentially a disease of childhood or occasionally of very young adult life. Furthermore, the great majority of patients seen at the Clinic, who have had malignant conditions of the lung died within a few months after the diagnosis was made.

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A CASE OF "MARBLE BONES" WITH PATHOLOGICAL FRACTURES*

BY A. S. MERRILL, M.D.

MANCHESTER, NEW HAMPSHIRE

R. D., male, aged thirty-seven. When patient was fifteen years old, he fractured the right leg and was laid up for three months. After getting up the right leg was found to be one and one-half inches shorter than the left leg. One year later he again fractured his leg, and was laid up for three or four months. On August 5, 1926, he fractured his right leg a third time. He was able to walk in five months without crutches. Abduction was 20 degrees, external rotation 20 degrees, with no pain. He stated that he was sliding when he fractured his leg the first time, and that later he twisted his foot and fractured the leg again. Union was firm after four months, and there was no tenderness around the callus. At the present time there is about two inches' shortening but the patient does not complain of pain.

FIG. 1.

Roentgen examination, Feb. 25, 1927, shows an old fracture of the femur just below the trochanters on the right, with callus formation and considerable bowing of the femur at this point, but no bony union. There is also an old fracture of the left femur at the junction of the middle and lower thirds, firmly united, with slight deformity. The bones all show a remarkable increase in density, being practically opaque to the roentgen rays. The vault and base of the skull are involved in the process, but the facial bones appear normal. There are peculiar ridges on the crests of the ilia, almost suggesting ununited epiphyses. (Figs. 1, 2, 3, 4 and 5.)

FIG. 2.

Diagnosis: "Marble bones,"—multiple fractures.

* Presented before the NEW ENGLAND ROENTGEN RAY SOCIETY, October 26, 1928.

Fig. 3.

Fig. 5.

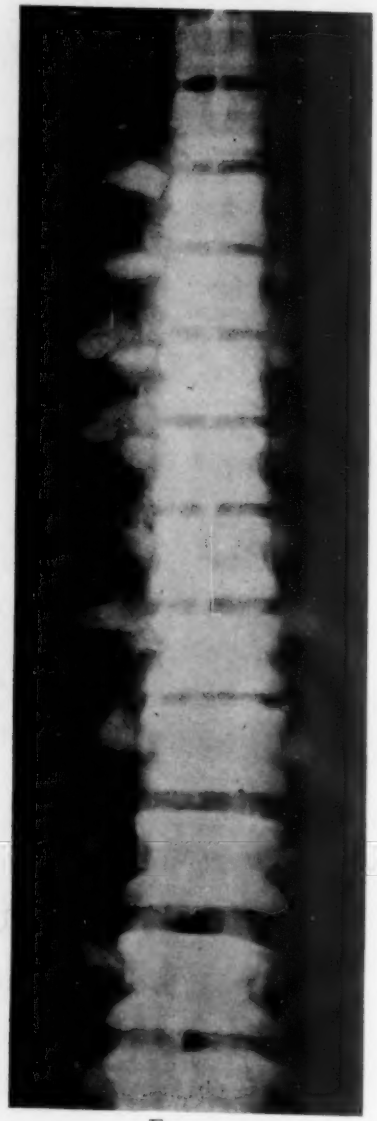

Fig. 4.

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A BENIGN SCLEROSING CENTRAL GIANT CELL TUMOR

CASE REPORT

BY JOHN R. CARTY, M.D.

Cornell University Medical College

NEW YORK CITY

WHILE rarefying benign giant cell tumors are not unusual among bone neoplasms, the occurrence of one showing calcium deposits is of sufficient interest to report.

FIG. 1. Before treatment. Note the central area of calcification with several cystic areas.

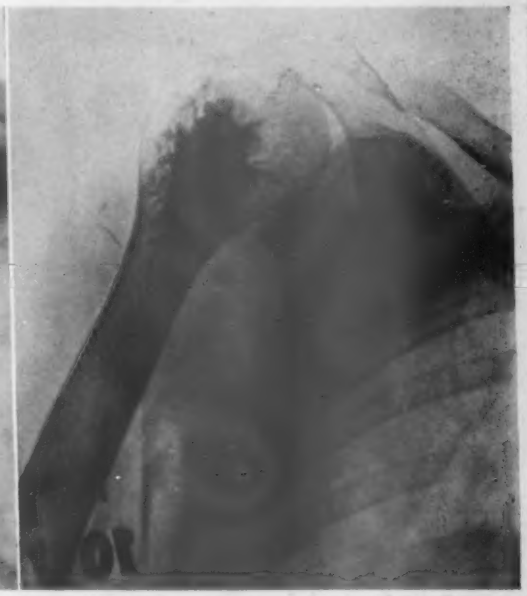

FIG. 2. Following treatment. Note that the lesion has become denser and that the cystic areas are barely visible. This tumor has the same reaction to roentgen irradiation as the rarefying type.

The patient, Mrs. R., a rather thin woman, aged sixty-four, came to the clinic complaining of a deep boring pain in the left shoulder for the past six months with occasional sharp radiating pains down the arm to the fingers. This has been growing progressively worse. Twelve years ago a similar pain was noted which, however, soon went away.

The general physical examination was essentially negative. Local examination showed slight atrophy of the muscles of the left shoulder. There was no swelling. There was moderate limitation of motion, particularly external rotation. Some tenderness over the deltoid was noted.

Stereoscopic roentgenograms of the left shoulder, taken when the patient was first admitted, showed a medullary calcified area involving the anatomical and surgical necks of the humerus. Within this area of calcification several small cysts were noted. The cortex was intact. Roentgen examination of the chest was negative.

Fifteen treatments of aluminum filtered, medium wave radiation of approximately one-half of the skin erythema dose were given over the shoulder for a period of a year. Following the third treatment, there was a definite improvement. The patient now has no pain, and the movements of her shoulder are normal.

Stereoscopic roentgenograms made following the last treatment, showed the process to be much denser and the cystic areas were barely visible.

Summary. A benign medullary sclerosing tumor of the upper end of the humerus is reported. The clinical history and roentgenographic appearance are suggestive of a giant cell tumor. The response to roentgen irradiation confirms this diagnosis.

A MEDIASTINAL CYST CAUSING OBSTRUCTION OF A BRONCHUS

CASE REPORT

BY EDWARD C. VOGT, M.D.

From the Infant's and Children's Hospitals

BOSTON, MASSACHUSETTS

ELSIE S., aged three months, was admitted to the Infant's Hospital, May 27, 1927, on account of wheezing and cyanotic attacks.

Family History. Unessential.

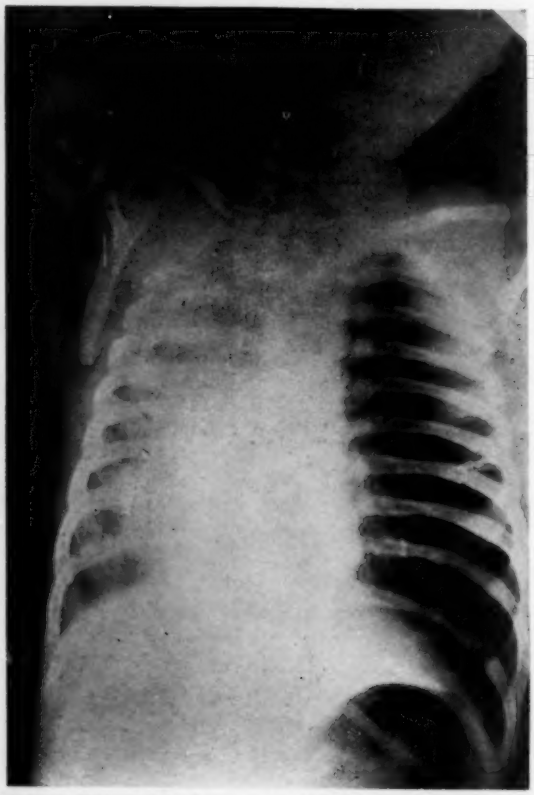

FIG. 1. Shows displacement of the heart and mediastinum to the right with a marked emphysema on the left.

Past History. Full term. Weight at birth 8 pounds. Breast fed. No acute illnesses or history of foreign body aspiration.

Present Illness. Wheezing was present at birth and became increasingly more pronounced. At one month of age she had a cyanotic spell which lasted about a minute. This recurred at intervals and became more frequent up to the time of entrance. The day before coming to the hospital she had five attacks.

Physical Examination. The child was well developed and fairly well nourished. There was extreme dyspnea of the expiratory type with a grunt. The entire body was very cyanotic and she was evidently in distress. There was diminished resonance over the right chest, dullness at the apex and base and a few râles. Air entry was evidently greater on the left. The heart was displaced to the right. Laboratory examination showed blood and urine essentially normal. Temperature: The patient was afebrile while in the hospital.

FIG. 2. Post-mortem drawing of the intrathoracic organs from behind showing the cyst wedged in between the vascular structures and the main bronchi.

Roentgen Findings. The heart and mediastinum were displaced to the right. The left lung was hyperaerated. Roentgenoscopy showed increased displacement of the heart and mediastinum to the right on expiration. The left diaphragm was low and almost immobile. The right moved freely. Diagnosis: Obstruction of the left main bronchus, probably foreign body (Fig. 1).

Bronchoscopy by Dr. L. G. Richards, on June 1, revealed a compressed left primary

bronchus just below the bifurcation, due evidently to extrinsic pressure, but no foreign body was found.

The child was obviously in poor condition and died the following day.

Autopsy. (Performed by Dr. Monroe Slessinger.) The left lung was very emphysematous encroaching on the heart and right thoracic cavity. There were no adhesions or excess fluid on either side. The heart and mediastinum were displaced to the right, compressing the lung on this side. Just below the bifurcation of the trachea was a smooth-walled translucent cyst about 1.5 cm. in diameter (Fig. 2). Anterior to the cyst was the left pulmonary artery and ascending aorta. Below was the left auricle. Behind was the spine and descending aorta. Above the aortic arch, a patent ductus arteriosus and the bronchi completed the surroundings of the cyst. The cyst, tense with fluid, was pressed up against the left primary bronchus just lateral to the bifurcation, but did not communicate with it. Attached to its posterior surface was a small knob about 2 mm. in diameter having the consistency of cartilage.

As all intrathoracic organs were preserved in toto no sections were made at this time.

Diagnosis. Dermoid cyst of mediastinum.*

* This case, with others, will be reviewed in more detail from the surgical and pathological standpoints by Drs. C. Mixter, S. Clifford and R. Schulz.

A CASE OF LITHOPEDION*

BY P. F. BUTLER, M.D.

Boston City Hospital

BOSTON, MASSACHUSETTS

PATIENT, aged thirty-four, was operated upon three years previous to roentgen examination for ruptured ectopic pregnancy.

Roentgen examination (Fig. 1) showed a small calcified fetus in upper right quadrant. At operation the fetus showed a faint membrane about the cranium, which was attached by adhesions to the second portion of the duodenum. A definite blood supply was found in these adhesions. Operation and removal of

FIG. 1.

FIG. 2.

Because of marked bleeding and poor condition, only the tube was tied off. The fetus was not seen. Health fairly good for three years after operation. Symptoms of past year pointed to gall-bladder pathology.

* Presented before the NEW ENGLAND ROENTGEN RAY SOCIETY, November 16, 1925.

the lithopedion have effected a complete cure. Figure 2 shows the lithopedion after removal.

Comment. Evidently this fetus was free in the abdomen at the time of the emergency operation. It migrated to the upper right quadrant and there became adherent to the second portion of the duodenum by adhesions. It developed a new blood supply through the adhesions. Calcium deposit apparently continued in the fetal skeleton but the soft tissues did not develop nor ossify.

A CASE OF ANENCEPHALY*

BY CURTIS H. JENNINGS, M.D.

FITCHBURG, MASSACHUSETTS

MRS. M. J. O'N., aged twenty-eight. Admitted to Elliot Community Hospital, Keene, N. H., July 6, 1928.

Fig. 1.

Family History. Essentially negative. Father and mother living and well. No history of malignancy, insanity, or abnormalities on either side.

Past History. Patient has been delivered of two healthy children, normal births, with normal convalescence. Has had no serious illnesses except the usual childhood diseases.

Present Illness. Patient has been under observation from the third month of pregnancy. Fetal motion was noted at the usual time, and continued up to the week before delivery. During the last week before delivery the patient noticed that the movements were not so strong nor so frequent as they had been up to that time. The patient went nearly four weeks beyond the date set for confinement, and during this month she would have, for a few hours, labor-like pains some time during the day, which would quiet down, to recur on the following day for practically the same length of time. In the course of the month this procedure occurred about half a dozen times. During this period the fetal heart sounds were heard up to within forty-eight hours of delivery.

To determine the size and position of the head, and to secure information on the presenting part which felt abnormal, a roentgenogram was taken (Fig. 1) which showed complete absence of the cranium, apparently a case of anencephaly.

The patient went into active labor four days later, and delivered herself of a dead fetus. The entire cranium, including the eyes and upper portion of the face, was missing. The maxillae and mandible were present, the latter being well developed. The fetus was otherwise apparently normal.

* Presented before the New England Roentgen Ray Society on October 26, 1928.

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Information of interest to all readers will be found on page ii.

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Thirtieth Annual Meeting: Hotel Pennsylvania, New York City, Sept. 17–20, 1929.

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EDITORIAL

THE TREATMENT OF LYMPHATIC LEUCEMIA

At present there is no specific medication or treatment known which will cure or materially affect the course of either chronic or acute lymphatic leucemia. The best symptomatic treatment appears to be some form of short wave length radiation, either the roentgen ray or one of the radioactive substances. It is probable that the actual length of life of the average patient is not prolonged by this method of treatment, although symptomatically there may be much improvement and in some cases, where mechanical features threaten the patient's life, irradiation of the lymph nodes may be a life saving procedure. Irradiation should be applied only after a careful study of the patient and the state of his blood. The small lymphocytes appear to be the most susceptible to roentgen rays or radium and the large lymphocytes appear to be relatively refractory. This factor often helps to suggest the prognosis, and when the presence of large lymphocytes increases in the peripheral blood stream the outlook becomes progressively worse. In the acute forms of the disease, which are probably comparatively rare, roentgen-ray or radium radiation has little or no effect, and at times may even be harmful.

Acute lymphatic leucemia is often confused with acute myeloblastic leucemia which is more common and which it resembles in some respects. However, neither of the forms is affected by roentgen or radium treatment. and both are rapidly fatal. The prognosis in chronic lymphatic leucemia may also be judged from the hemoglobin percentage. The outlook is better if the hemoglobin is above 50 per cent, or if it can be raised above this point after irradiation or by other treatment. In this connection it seems that whole liver therapy, as used in pernicious anemia, may be of some value. Anemia itself is not a contraindication to radiation therapy. Decrease in the number of blood platelets is also of bad prognostic import. It must be remembered that with progressive irradiation there is a tendency for the lymphocytes to develop only to the more immature stages so that the treatment becomes less and less effective. For this reason radiation treatment should be withheld until there is very definite indication for its use. Large lymph nodes pressing on vital organs causing interference with function, progressive anemia, progressive malaise and ease of fatigue, and increase in the basal metabolic rate are all indications for treatment. These factors may also be the guide in the treatment of the aleucemic form of the disease. Certainly there is no place in this disease for routine treatment at regular intervals as is sometimes practised. The treatment is directed to the part of the body showing the most active lesion, but remote effects in other parts of the body are also noted. There is some difference of opinion as to whether the maximum dosage should be given at once, or whether it should be given in fractions over a longer period of time. The history of the development of the treatment for pernicious anemia suggests that experimental work along dietetic or organotherapeutic lines may be profitable, as the two diseases have some features in common. The lymphocytes which are produced in such great numbers in the blood stream are probably not normal lymphocytes but bear the same relation to the normal cells as cancer cells do to the tissue from which they develop. While the average patient lives 3.45 years, in some individuals the course of the disease is very rapid, whereas others, regardless of treatment or no treatment, live a decade or longer. There is some other factor than the mere pathological changes in the lymph nodes which determines how rapidly the disease will progress and how long the patient will live. It is the study of this constitutional factor which offers some hope for further progress in the disease from the point of view of immunity and therapy.

Raphael Isaacs.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

United States of America

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. John T. Murphy, 421 Michigan Ave., Toledo, Ohio.
Thirtieth annual meeting: Hotel Pennsylvania, New York City, Sept. 17–20, 1929.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. Albert Soiland, 1407 S. Hope St., Los Angeles, Calif.
Annual meeting, Portland, Oregon, 1929.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. Fred M. Hodges, 801 West Grace St., Richmond, Va.
Annual meeting, Portland, Oregon, July 8–12, 1929.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. Walter T. Bronson, Northwestern Univ. Med. School, Chicago, Ill.
Fifteenth annual session: New Royal York Hotel, Toronto, Canada, Dec. 2–6, 1929.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, Dr. Lowell S. Goin, Wilshire Medical Building, Los Angeles.
Meets on the third Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. W. S. Lawrence, Medical Arts Bldg., Memphis, Tenn.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St.
Meets second Monday of each month except during the summer months, the place of meeting to be selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. W. T. Bronson, Englewood Hospital.
Meets monthly on second Thursday from October to May (except during month of December) at Virginia Hotel. Dinner at 6 P.M., scientific session at 8 P.M.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Harry L. Farmer, 2930 Prospect Ave.
Meetings are held at 6 o'clock at the University Club, on the fourth Monday evening of each month from September to April, inclusive.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. R. Witwer, Harper Hospital.
Meets monthly on second Friday from October to May, at Wayne County Medical Society Building.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. C. Kariher, Decatur, Illinois.
Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind.
Annual meeting each February 22 in Indianapolis.
Next meeting in Evansville, Ind., June, 1929.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. J. E. Habbe, 221 Wisconsin Ave., Milwaukee.
Meets first Friday in October, December, February and April.
Place of meeting designated by the president.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. M. C. Sosman, Peter Bent Brigham Hospital, Boston, Mass.
Meets monthly on third Friday, Boston Medical Library.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. Everett Rowell, 200 West 59th St.
Meets monthly on third Monday, New York Academy of Medicine.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. D. S. Childs, 316 Gurney Bldg., Syracuse, N. Y. Three meetings a year—April, August and November.

PACIFIC COAST ROENTGEN RAY SOCIETY
Secretary, Dr. Harold B. Thompson, Seattle, Wash.
Two meetings a year.

ROENTGEN RAY SOCIETY OF CENTRAL PENNSYLVANIA
Secretary, Dr. W. E. Reiley, Clearfield, Penna.
Two meetings a year, April and October.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary Dr. John T. Farrell, Jr., 235 S. 15th St., Philadelphia.
Meets monthly on first Thursday evening, Pennsylvania Hospital.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N. Y.
Secretary, Dr. James M. Flynn, 282 Alexander St.
Meets monthly on the first Friday evening at 7.45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN CLUB
Secretary-Treasurer, Dr. L. R. Sante, Metropolitan Building.
Meets first week of each month. Time and place of meetings designated by president.

TEXAS RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. C. P. Harris, Houston, Texas.
Meets annually one day preceding the meeting of the Texas State Medical Association.

VIRGINIA ROENTGEN RAY CLUB
Secretary, Dr. Wright Clarkson, 205 S. Sycamore St., Petersburg, Va.
Annual meeting, Charlottesville, Va., Oct. 18, 1929.

British Empire

BRITISH INSTITUTE OF RADIOLOGY INCORPORATED WITH THE RÖNTGEN SOCIETY
Director, Dr. John Muir, 32 Welbeck St., London, W. 1.

* Secretaries of societies not here listed are requested to send the necessary information to the editor.

Meets on the third Thursday of each month, from November to June inclusive, at 8.15 P.M., at 32 Welbeck St., London, W. 1., or as advertised.

ELECTRO-THERAPEUTIC SECTION OF THE ROYAL SOCIETY OF MEDICINE (CONFINED TO MEDICAL MEMBERS)

Meets on the third Friday of each month during the winter at 8. 30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

SECTION OF RADIOLOGY AND MEDICAL ELECTRICITY, AUSTRALASIAN MEDICAL CONGRESS

Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Third session, Sydney, Sept. 2–7, 1929.

RADIOLOGICAL SECTION OF THE VICTORIAN BRANCH OF THE BRITISH MEDICAL ASSOCIATION

Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.

Meets monthly at Melbourne during the winter.

SECTION ON RADIOLOGY, CANADIAN MEDICAL ASSOCIATION

Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

RADIOLOGICAL SECTION, NEW ZEALAND BRITISH MEDICAL ASSOCIATION

Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch.

Meets annually.

Continental Europe

BELGIAN SOCIETY OF ROENTGENOLOGY

Secretary, Dr. J. Boine, Avenue des Alliés, 134, Louvain (Belgium).

Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

SOCIETE DE RADIOLOGIE MÉDICALE DE FRANCE

Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

SOCIETE FRANCAISE D'ELECTROTHÉRAPIE ET DE RADIOLOGIE MÉDICALE

Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

ASSOCIATION OF GERMAN ROENTGENOLOGISTS AND RADIOLOGISTS IN CZECHO-SLOVAKIA

Secretary, Dr. Walter Altschul, German University, Prague, 11/52.

DEUTSCHE RÖNTGEN-GESELLSCHAFT (GESELLSCHAFT FÜR RÖNTGENKUNDE UND STRAHLENFORSCHUNG)

Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.

Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

SUD- UND WESTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

NORD- UND OSTDEUTSCHE RÖNTGENGESELLSCHAFT

Meets annually in different cities.

DUTCH SOCIETY OF ELECTROLOGY AND ROENTGENOLOGY

Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

SOCIETA ITALIANA RADIOLOGIA MEDICA

Secretary, Professor M. Ponzio, University of Turin, Turin.

ALL-RUSSIAN ROENTGEN RAY ASSOCIATION, LENINGRAD, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.

Secretaries, Drs. S. A. Reinberg and S. G. Simonson.

Meets annually.

Sixth Annual Meeting, 1929, to be announced.

LENINGRAD ROENTGEN RAY SOCIETY

Secretaries, Drs. S. G. Simonson and G. A. Gusterin.

Meets monthly on the first Monday at 8 o'clock in the State Institute of Roentgenology and Radiology, Leningrad.

MOSCOW ROENTGEN RAY SOCIETY

Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.

Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. A. Elektorowicz, 19 Hoza St., Warsaw.

Meets annually.

WARSAW SECTION, POLISH SOCIETY OF RADIOLOGY

Secretary, Dr. B. Krynski, 11 Zielna St.

Meets once a month except in the summertime.

SCANDINAVIAN ROENTGEN SOCIETIES

The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with the exception of the Denmark Society, meets every second month except in the summertime:

SOCIETY OF MEDICAL RADIOLOGY OF SWEDEN

Meets in Stockholm.

SOCIETY OF MEDICAL RADIOLOGY IN NORWAY

Meets in Oslo.

SOCIETY OF MEDICAL RADIOLOGY IN DENMARK

Secretary, Dr. H. Scheuermann, Copenhagen

Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

SOCIETY OF MEDICAL RADIOLOGY IN FINLAND

Meets in Helsingfors.

VIENNA SOCIETY OF ROENTGENOLOGY

Secretary, Professor Holzknecht, Vienna, IX, General Hospital.

Meets on the first Tuesday of each month from October to July.

AMERICAN RADIUM SOCIETY

The American Radium Society will hold its fourteenth annual meeting in Portland, Oregon, at the Heathman Hotel, Monday and Tuesday, July 8 and 9, 1929. The Program and Local Arrangements Committees have arranged a most interesting scientific program. The following is a tentative arrangement.

JULY 8, 1929, MORNING SESSION

1. Dr. E. G. Ernst. President's Address.
2. Dr. Edith H. Quimby. "A Comparison of Radium and Radon Needles and Permanent Radon Implants."
3. Dr. R. L. Sante. "Cell Nutrition—One of the Largest Factors Governing Radiosensitivity."
4. Dr. Hayes E. Martin and Dr. Edith H. Quimby. "Calculations of Tissue Dosage in Radiation Therapy, a Preliminary Report."
5. Dr. Rollin H. Stevens. "Comments on Radium Technique."
   Discussion: Dr. G. E. Pfahler, Dr. G. W. Grier, Dr. John R. Ranson.
6. Dr. D. T. Quigley. "How Shall Modern Science Orient Cancer."
   Discussion: Dr. O. L. Norsworthy, Dr. L. T. LeWald.

JULY 8, 1929, AFTERNOON SESSION

7. Dr. Joseph C. Bloodgood. Title to be Announced.
8. Dr. Francis Carter Wood. "Experimental Studies on Lead Therapy."
9. Dr. Sanford Withers. "Therapeutic Lead Poisoning."
10. Dr. H. J. Ullmann. "Observations on Lead Therapy."
    Discussion: Dr. Albert Soiland, Dr. E. G. Beck.
11. Dr. G. W. Grier. "Radium as a Palliative Agent."
12. Dr. E. G. Beck. "Open Surgery as an Aid to Efficient Postoperative Radiation and as a Prevention of Recurrence."
13. Dr. M. J. Sittenfield. "The Relative Value of Radium in Malignant Disease as Compared to the Accepted Methods of Surgical Procedure."
    Discussion: Dr. Henry Schmitz, Dr. R. L. Sante.

JULY 9, 1929, MORNING SESSION

14. Dr. G. E. Pfahler. "The Treatment of Cancer of the Mouth by Means of Radium."
15. Dr. Albert Soiland and Dr. William E. Costolow. "The Treatment of Epulis."
16. Dr. G. Allen Robinson. "Radium in the Treatment of Neoplastic and Diseased Tonsils."
17. Dr. F. A. Figi. "The Treatment of Malignant Tumors of the Mouth and Throat."
    Discussion: Dr. E. H. Skinner, Dr. W. H. McGuffin, Dr. Sanford Withers.
18. Dr. James A. Corscaden. "Further Indications for the Artificial Menopause."
19. Dr. E. H. Skinner. "The Rational Uses of Radium in Hemorrhagic and Fibrotic Tendencies of the Menopausal Period."
    Discussion: Dr. D. T. Quigley, Dr. W. E. Costolow.
20. Dr. Solomon Ginsburg. "The Value and Place of Radium in Treatment of Diseases of the Thyroid Gland."
    Discussion: Dr. R. E. Loucks.

JULY 9, 1929, AFTERNOON SESSION

21. Dr. O. L. Norsworthy. "A Study of the Uterine Cervix with Special Reference to the Use of Radium.
22. Dr. Henry Schmitz. "Late Complications in the Urinary Tract Following Radiation Therapy for Carcinoma of the Uterine Cervix."
23. Dr. H. H. Bowing and Dr. J. H. Bliss. "Results Obtained in the Treatment of Cancer of the Cervix Uteri with Radium and Roentgen Rays, from 1915 to 1923 inclusive."
    Discussion: Dr. Rollin H. Stevens, Dr. M. J. Sittenfield, Dr. J. T. Case.

All members of radiological societies and the Section on Radiology of the American Medical Association are cordially invited to attend both the banquet and the scientific sessions.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY & RADIUM THERAPY *visiting New York City are invited to make the office of the publishers (Paul B. Hoeber, Inc., 76 Fifth Avenue, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

DEPARTMENT OF TECHNIQUE

Department Editor: David R. Bowen, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

AN IMPROVED ENEMA TIP*

BY E. C. VOGT, M.D., AND W. H. LEE

BOSTON, MASSACHUSETTS

ANYONE attempting the examination of the colon of infants and small children by means of the opaque enema will appreciate the difficulties encountered. The procedure is not only disagreeable on account of the incontinence of the patient, but complete filling is usually impossible.

For about a year we have been using successfully an enema tip designed to give positive retention (Fig. 1). The instrument is made from a solid brass rod 1 cm. in diameter and 7 cm. long, with a flange at the base. A hole 4 mm. in diameter is drilled through the longitudinal axis for the passage of barium. Another small hole is drilled in the side wall parallel to the central one and made to extend from the base to the mid shaft. This is to be used as an air vent. The distal end of the instrument is shaped to a blunt tip. From just behind the tip to the middle of the shaft the brass is turned down to the level of the small hole in the side wall, thus connecting the excavated area with the air vent.

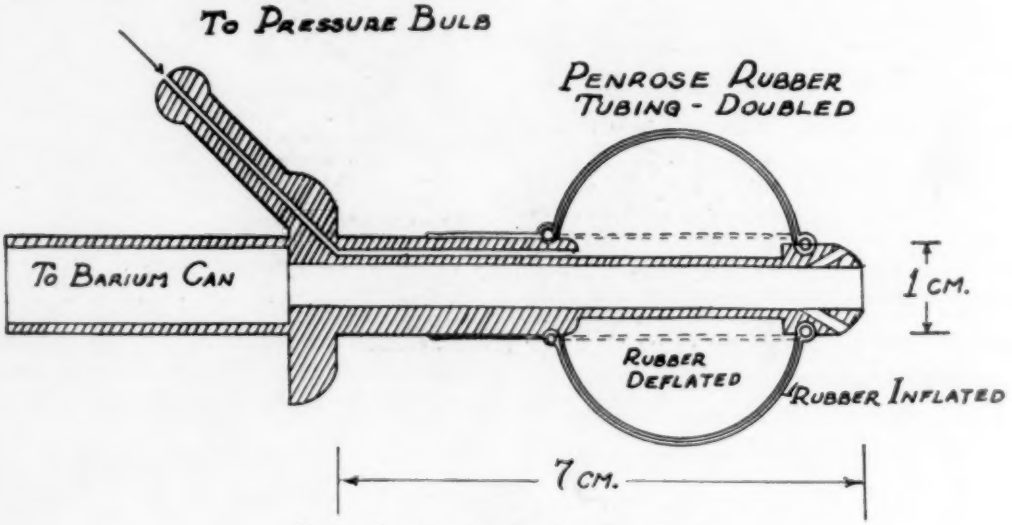

Fig. 1. Cross-section drawing of enema tip.

Small circular grooves at the middle of the shaft and at the tip are provided for ties. A piece of thin penrose rubber tubing is slid over the end of the instrument, tied securely at each of the two grooves and folded back over the shaft to cover the ties and give a double thickness of rubber.

We now have a closed air chamber with a flexible outer wall. A small curved metal tube is welded over the end of the air vent at the base for connection with an air pressure bulb. Another larger tube is welded over the central hole for connection with the enema supply can.

When used the tip is lubricated and inserted to the flange at the base. By means of the pressure bulb the air chamber is inflated to form a soft air cushion plug

* From the Department of Roentgenology of the Infant's and Children's Hospitals, Boston.

just inside the sphincter (Fig. 2). The amount of inflation necessary will depend to some extent on the size of the patient and should be checked by the roentgenoscope before the barium is injected. The supply can should not be more than 3 feet above the level of the patient as the pressure might be too great for the bowel wall.

Although originally designed for small children the instrument is of equal value for incontinent adults. It may also be used for giving high cleansing enemas, rectal clysis or rectal anesthesia.

Fig. 2. Roentgenogram of a case of Hirschsprung's disease with enema tip in place. Note air bubble just inside the sphincter.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

THE THEORY AND PRACTICE OF RADIOLOGY, WITH A SYNOPSIS OF RADIOGRAPHY AND RADIOTHERAPY. A Treatise in Four Volumes. By Bernard J. Leggett, M.R.C.S., L.R.C.P., A.M.I.E.E. Radiologist, East London Hospital for Children; Staff Radiologist, City of London Hospital for Diseases of Heart and Lungs, etc. Volumes I, II and III. Cloth. St. Louis: C. V. Mosby Co., 1928.

"The increasing complication of all X-ray apparatus for medical work is making it more and more necessary for medical students, doctors and radiologists to possess a wide knowledge of the physical and electrical principles involved." Every progressive member of the medical profession will heartily subscribe to this first sentence in the preface of Leggett's book, the first three volumes of which are to be reviewed here.

The first volume is devoted entirely to "Electrical Therapy Applied to Radiology." There are chapters on mechanical units, the dielectric circuit, electric and magnetic circuits, varying currents, electromagnetic machinery, and the electron theory. The author goes into great detail; as a matter of fact, this first volume represents more or less a textbook on electricity and magnetism. Only the last chapter on the electron theory is somewhat meager; however, this shortcoming is counterbalanced in the second volume, beginning on page 39.

The second volume "The Physics and Measurement of X-radiation" has been subdivided into chapters on light and heat, origin of *x*-radiation, *x*-radiation spectroscopy, properties of *x*-radiation, the measurements of quality and of intensity of radiation, and protection against the dangers of radiology. In an appendix, the recommendations relating to *x*-ray protection as suggested by British, German, Russian, Swedish, and American roentgenologists and also the German recommendations relating to dosage are reprinted. Like the first volume, it is profusely illustrated, a fact by which the discussion of *x*-ray spectroscopy profits most. The chapters on measurements are good from a historical standpoint but they do not give a complete account of the present status of dosimetry. It seems also strange that among the journals mentioned for reference, "*Radiology*" and "*Strablentberapie*" are missing entirely. Undoubtedly in these periodicals, many an important paper dealing with the standardization of *x*-ray measurements can be located.

The third volume looks at first sight almost like a united manufacturers catalogue; but as the author states in the preface, "No apology is made for the inclusion of a very large number of manufacturers' blocks in this section, for it must be recollected that invariably the medical radiologist purchases his apparatus, and hence quite 99.5 per cent. of his requirements are supplied by manufacturers." Outstanding among the various chapters is a discussion of the roentgen-ray tube. For those who are planning a new roentgen department, the description of a number of well-organized laboratories, accompanied by diagrams and illustrations might prove of value. Another feature of all three volumes is the chance offered to the student to check up on his knowledge of the subject. To each chapter is appended a group of general questions, similar to those asked in the D.R.M.E. examination in Cambridge.

The author has collected in these three volumes an enormous material which should provide a welcome source of information, and serve also for daily reference. We look forward with interest to the fourth volume discussing diagnostic and therapeutic radiology.

E. A. POHLE.

GRENZSTRAHL-THERAPIE. By Gustav Bucky, M.D., New York, Otto Glasser, PH. D., Cleveland, and Olga Becker-Manheimer, M.D., Hamburg. Pp. 150, with 40 illustrations. Leipzig: S. Hirzel, 1928.

It is a difficult task indeed to write a critical report on this book published by Bucky and his coworkers, because there is not enough material available on the subject to permit final conclusions. A number of investigators who have dealt with the problem of roentgen rays of long wave length, both from the experimental and clinical point of view, do not confirm Bucky's findings. However, there are others who agree with him in certain points. Judging from the most reliable publications, it seems reasonable to assume that the exclusive place claimed for these rays is not warranted. They are roentgen rays of long

wave length with all the characteristics of roentgen rays.

Following chapters on the history and on the principles of "grenz-ray therapy" by Bucky himself, Glasser outlines in thirty pages the physical foundations of low voltage roentgen-ray therapy. The spectral intensity curves as reprinted from Küstner's work have to be corrected because they contain an error in calculation (see *Strahlentherapie*, 1928, xxx, 334). He concludes that the dosage of these long rays is possible now in R units if a suitable chamber is attached to the ionization instrument. Goldbeater's skin appeared to be an excellent material for the chamber wall (see this Journal, 1928, xix, 442). Bucky continues then with chapters on technique, clinical symptoms, and danger of "grenz-ray" therapy. One of his coworkers, Olga Becker-Manheimer, contributes a brief article on the leucocyte drop following exposure to "grenz rays." The last two chapters by Bucky relate his clinical experience with these rays of long wave length in the treatment of skin diseases and of internal diseases. Before the striking results reported, for instance, in cases of duodenal ulcer, polycythemia, angina pectoris, obstipation, and neurasthenia, can be generally accepted, other clinics must confirm his observations.

There is no doubt that anybody who intends to work with rays of long wave length (1–2 Angströms) should study Bucky's publication. A complete presentation of this subject is desirable because any future discussion can be conducted more intelligently on such a basis. An English translation of the monograph will appear in the near future.

E. A. Pohle.

Internationale Radiotherapie. Besprechungswerk auf dem Gebiete der Röntgen-, Curie-, Licht- und Elektrotherapie. Volume II, 1926–1927; Volume III, 1927–1928. Organized and edited by J. Wetterer, M.D., Mannheim. Cloth. Darmstadt: L. C. Wittich, 1927, 1928.

The character of this work has not changed from that of the first volume which was reviewed in this Journal (1926, xvi, 579). It is noted that the suggestion of the reviewer at that time to add an adequate subject index has met with response. This indeed facilitates the perusal of the book.

In the second volume we find besides the abstracts of papers taken from the international literature of 1926–1927, monographs on the following subjects:

1. The roentgen-ray apparatus in international radiation therapy of the years 1924–1927. By M. Brenzinger.

2 The measurement of the roentgen-ray doses in America in 1926–1927. By Arthur Erskine.

3. The question of the roentgen dose unit "R" in therapy. By Robert Jäger.

4. Progress in construction and in application of the standardization instrument. By H. Küstner.

5. Comparative study of the French and German R unit. By J. Solomon.

6. Historical review of the development of curie therapy from its beginning to June, 1927. By P. Degrais.

7. The development of roentgen and curie therapy in France, 1924–1927. By R. Coliez.

8. The development of the method of Ghilarducci during the past years. By S. Attilj.

9. The roentgen therapy of ulcerated skin cancer with the method of Ghilarducci. By C. Guarini.

10. Regulation and control of radiation therapy of cancer. By F. Perussia.

11. On the biology of roentgen rays. By K. Kovacs.

12. The present status of prophylactic treatment of cancer of the breast. By B. Guedes.

13. The roentgen therapy of intracranial neoplasm. By W. Alberti.

14. Latest results in radiation therapy of diseases of the circulatory system. By F. Weiss.

15. On the roentgen therapy of leucemic diseases. By F. Bardachzi.

16. The physical investigations of the efficiency of suprarenals and thyroid. By P. M. France.

17. Roentgen therapy in urology. By J. Wetterer.

18. Roentgenology in ophthalmology. By W. Hoffmann.

19. Light therapy in gynecology. By H. Guthmann.

20. The treatment of cancer of the larynx. By Dr. Ledoux and F. Sluys.

21. Necrosis following radiation therapy. By A. P. Lachapele.

22. The development of roentgen therapy from its beginning up to date. By J. Wetterer.

23. The radiotherapy of the gynecologist. By W. Lahm.

There has been added an open forum where questions of general interest to radiologists may be discussed by the readers.

The third volume which covers the literature from 1927–1928 offers in addition the following monographs:

1. The cosine law and its practical application in the ionometric measurement of the distribution of roentgen rays and gamma rays of radium on irradiated surfaces. By G. G. Palmieri.

2. Secondary radiation in roentgen therapy. By M. Ponzio.

3. Injuries of the skin and of the mucosa due to gamma rays of radium. By R. Coliez.

4. The biological effects of radiation on the endocrine glands. By S. Recasens.

5. The sensitivity of the fibroid uterus and its therapeutic importance. By M. Spinelli.

6. Clinical consideration concerning deep therapy in gynecology. By W. Lahm.

7. The latest results in the investigations of the biology of cancer cells. By A. H. Roffo.

8. Clinical prognosis of radiation therapy in cancer. By G. Holzknecht.

9. Should the biopsy of tumors be recommended or discouraged? By D. Chilaiditi.

10. The radiation and surgical treatment of cancer of the tongue. By G. Jeanneney.

11. Carcinoma of the cervix uteri. By H. Schmitz.

12. Results of roentgen deep therapy in tuberculosis of the lungs. By R. Gassul.

13. The radiation therapy of Graves' disease. By M. Franco.

14. On the roentgen therapy of Graves' disease. By F. Bardachzi.

15. On the roentgen therapy of acute and subacute inflammatory processes. By P. Abbati.

16. International investigations on the treatment of cancer. By W. Lahm.

17. The First International Cancer Conference in London, in July, 1928. By W. Lahm.

18. The Second International Radiological Congress in Stockholm, 1928. By W. Lahm.

19. Report on physical and technical questions discussed during the Second International Congress in Stockholm, with particular consideration of dosimetry and protection against radiation. By R. Jäger.

20. International Committee on roentgen standardization. By R. Jäger.

21. Standardization in the technique of roentgenology. By B. Rajewski.

22. The question of the unit of roentgen-ray intensity before the International Congress in Stockholm. By I. Solomon.

23. Contribution regarding the choice of an international roentgen-ray unit. By C. Declairfayt.

24. The intensimeter and dosimeter for roentgen rays constructed by Baastrup and Johnson. By Chr. Baastrup and A. Johnson.

25. Experience with the dose recorder "Mekapion;" accuracy of the instrument. By J. Wetterer.

26. How does the practising physician test a diathermy apparatus? By M. J. Purtschert.

27. Thirty-two years of light therapy. By Dr. Axmann.

28. Effect and indications of the quartz mercury vapor lamp "Künstliche Höhensonne." By H. Bach.

29. On the question of the effect of roentgen rays on physicochemical, biological, and osmotic processes. By K. Kovacs.

30. Bioradioactivity and radiating substance. By H. Zwaardemaker.

31. On the knowledge of the effect of light on plants. By J. Stephan.

32. On the question of injuries due to roentgen rays. By R. Balli.

33. Radium treatment of the hemangioma. By F. Dautwitz.

34. Vaginal heliotherapy according to Landeker in gynecological diseases. By A. Landeker.

35. The combination of roentgen therapy with intravenous injections of glucose in malignant tumors. By C. Guarini.

36. Reflections regarding the roentgen therapy of epithelial tumors of the tongue and of the uterus. By J. Landaburu.

37. Optimal conditions as basis of optimal results in the treatment of cancer of the cervix. By W. Lahm.

38. The radiation treatment of cancer of the breast. By B. Guedes.

39. The light therapy of tuberculosis of the bones and joints. By A. Rollier.

40. On the treatment of surgical tuberculosis with radioactive substances. By F. Dautwitz.

41. The radiation therapy of tuberculous diseases of the eye. By W. Hoffmann.

42. The radiation therapy of diseases of the stomach. By R. Weiss.

43. Two remarkable cases of blood diseases. By A. Grosglik.

44. The roentgen therapy of inner secretory disease. By W. Alberti.

45. The light therapy of disturbances of metabolism. By H. Malten.

46. A case of chronic anterior poliomyelitis treated by radiothermo-therapy seventeen years ago. By H. Bordier.

47. The present status of physical therapy of Heine-Medin's disease. By A. d'Istria.

48. The radiation therapy of nervous and psychiatric diseases. By H. D. von Witzleben.

49. Roentgen and curie therapy in odontology. By L. Barail.

50. The roentgen therapy of acute infectious processes. By S. Attilj.

51. The radiation therapy of malignant diseases of the skin. By J. Wetterer.

In table form, F. Dautwitz presents a record of the most important radioactive springs in Europe and overseas. J. Wetterer has compiled in a long list the results of researches in radiol-

ogy up to 1925, giving in each instance the name of the investigator. This should, in his opinion, be of help in establishing priority.

There is no doubt that an immense amount of painstaking work is represented in these three volumes. While no one will question that the effort is well spent as far as the monographs are concerned, some doubt must be voiced regarding the abstracts. For several years the "*Zentralblatt für Radiologie*" has been published in Berlin; it offers the most complete survey of the international literature on radiology and its related branches in form of abstracts known to the writer. The question arises then whether such a duplication of work is necessary or wise. This very personal thought should by no means detract from the value of Wetterer's "Internationale Radiotherapie."

E. A. Pohle.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

Albrecht, H. U. Annular shadows in roentgenograms of the lungs. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 367–371.

The author emphasizes the cavernous nature of the annular shadows observed in the roentgenograms of the lungs. Pleural adhesions or circumscribed pneumothorax may in some cases be responsible for the production of such annular shadows; however, they should be considered only in cases where tuberculosis has been excluded. The contention of Bruns and Barnwell that every annular shadow occurring in a tuberculous lung ought to be considered as a cavity unless proven otherwise is endorsed by the author.

In the cases observed there was a rather rapid change in the form and size of the different annular shadows as evidenced in roentgenograms taken at short intervals, a condition which cannot be explained on the basis of tuberculous cavities alone. Therefore the author thinks that certain other factors as yet unknown play an important part in the production of annular shadows.—*T. Leucutia.*

Albrecht, H. U. Duodenal diverticula. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 605–619.

Clairmont and Schinz consider the following roentgen signs as positive for duodenal diverticula: (1) a spot-like shadow with good filling and sharp contours within the duodenum; (2) the passage of part of the contrast meal over or near the spot-like shadow into the aboral duodenum and jejunum; (3) the permanence of the spot-like shadow with emptying of the rest of the duodenum; (4) a retention over several hours or days. One might add as a fifth facultative sign in case of inflammation of the diverticulum, a localized tenderness on pressure corresponding to the site of the spot-like shadow.

In correlating the above signs with the clinical symptoms on the basis of 20 cases of his own, the author arrives at the conclusion that there is no typical pathognomonic symptomatology in duodenal diverticula but that the following symptoms are more or less of value: the long duration of the disease, the persistence of the complaints, the frequent loss of appetite, and nausea, the pain in the upper abdomen which as a rule is described as a pressure sensation. In 2 cases there was entire lack of symptoms on empty stomach and there was increase in the severity of the symptoms toward evening. In a great majority of the cases there was subacidity or anacidity. The average age was 52.8 years. Unlike Oehnell's cases of duodenal diverticula which resembled the picture of gastric or duodenal ulcer, in Albrecht's cases the symptomatology was more similar to that of gastric carcinoma or cholecystopathies. At any rate there was no periodicity of the symptoms such as is observed in ulcer patients. All diverticula were pedunculated. In 11 cases out of 17 there was a marked retention of the barium for several hours or days. The length, width and position of the peduncle is very important with regard to the retention.

Duodenal diverticula should not be considered merely as an accidental discovery of insignificant importance but should immediately be treated. Good results are obtained by conservative therapy (rest, strong diet, thermophore, Nujol). Surgical procedures should be used only as a last resort.

—*T. Leucutia.*

Berry, Frank B. Massive atelectasis complicating paravertebral thoracoplasty for pulmonary tuberculosis. *Arch. Surg.*, Jan., 1929, xviii, 257–270.

Berry reports 4 cases of atelectasis following thoracoplasty for pulmonary tuberculosis. These cases were thought to have pneumonia at first, but later termed massive atelectasis due to inspissated material from the diseased lung. Three of these cases followed a one-stage operation.—*E. P. Pendergrass.*

Bársony, Th. A typical form of lumbosacral osteochondropathy. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 92–96.

The large group of neuralgias and rheumatic diseases is continually being narrowed down by the separation of some new clinically and pathologically well-characterized entity. Such a condition is marginal osteosclerosis, a typical form of lumbosacral osteochondropathy.

The most important features of this disease are the narrowing of the disc between the fifth lumbar vertebra and the sacrum, the irregularity in the contour of the disc and the pronounced thickening (sclerosis) of the adjacent portions of the sacrum and of the fifth lumbar vertebra. The condition is localized,

in the majority of the cases, to the disc between the sacrum and the fifth lumbar vertebra; in rarer cases to the intervertebral disc between the fourth and fifth lumbar vertebrae. Occasionally, the intervertebral discs of the lower cervical vertebrae (sixth to seventh) may also form the site of the lesion.

Special attention is called to the fact that this lesion, especially in its lumbosacral manifestation, can often be demonstrated roentgenologically only by applying a special technique (dorsoventral position, caudocranial incidence). In every instance of unexplained back pain or rheumatic neuralgia a roentgenogram should be taken with this technique.

—*T. Leucutia.*

Birkenfeld, Werner. On the heredity of brachyphalangia. *Arch. f. klin. Chir.*, 1928, cli, 611–631.

Brachyphalangia is a shortening of one or more finger bones due to anomalous development. As a rule it appears after the age of ten, in some instances, however, after the age of three, and consists in a premature ossification of the epiphyseal line leading to a cessation of the longitudinal growth of the bone, while the periosteal and endosteal bone formation continues normally. Roentgenologically the affected bones appear short and thick, giving a plump, quadrangular or pear-shaped appearance. Pol gives the following table with regard to the frequency of occurrence of brachyphalangia of the different bones:

Foot.....	5	4	3	2	1
Hand.....	5	2	4	3	1

Sometimes the process is multiple and extends also to the metacarpals.

The author has collected 101 cases of brachyphalangia from the literature and adding 2 cases of his own, he analyzes the importance of heredity in this condition. It was found that brachyphalangia is hereditary, however without predilection for either sex. True, it occurs about one-third more frequently in females than in males but it is transmitted equally through both sexes.—*T. Leucutia.*

Boeminghaus, H. The diagnosis of ureteral stones. *Arch. f. klin. Chir.*, 1928, cli, 565–577.

Urinary stones as a rule are the result of physico-chemical factors as well as of an irritative state of the sympathetic and parasympathetic nervous system. An example of the first is the phosphaturia, oxaluria and uraturia in neuropathic individuals (secretion neurosis of Minkowski), while in the second case a more or less constant irritation of the vagus or a decrease in the tonicity of the sympathicus produces a change in the calcium metabolism, often leading to urinary stone formation.

It is an interesting observation that since the war there has been a considerable increase in the frequency of ureteral calculi while the vesical and renal calculi have remained about the same. In discussing the clinical symptomatology from the standpoint of differential diagnosis, the author emphasizes the fact that a reflex rigidity of the abdominal wall and meteorism may be observed also in cases of acute colic of urinary calculi.

A simple roentgenogram is not sufficient for the diagnosis of ureteral stones. While statistics show that in case of renal calculi the roentgenographic examination may be negative in 5 to 15 per cent of the cases, in ureteral calculi this number increases to 20 to 30 per cent.

Whenever a suspicious shadow is observed in the roentgenogram or in cases with positive clinical symptoms but negative roentgen findings, catheterization of the ureter is indicated. The catheterization should always be associated with pyelography. The advantages of ureteral pyelography are: (1) in case of a positive roentgen finding it permits the differentiation between a ureteral calculus and a shadow originating from some other calcification (calcified glands, phleboliths, etc.); (2) in case of negative roentgen findings it permits the demonstration of a stone if such is present; (3) it leads to the detection of complications originating from the kidney or ureter, which is very important from the point of view of therapeutic intervention.

Stereoscopic roentgenograms are of no aid in diagnosis by pyeloureterography, and in fact in some instances they are confusing.

—*T. Leucutia.*

Butler, Paul F., and Dana, Harold W. Diaphragm excursions, normal and pathologic. *Am. J. M. Sc.*, Oct., 1928, clxxvi, 569–577.

Butler and Dana in a study of the movements of the diaphragm in 62 patients, some normal and some pathological, arrive at the following conclusions.

Roentgenoscopic tracings taken in both lateral recumbent positions are of value in recognizing pathological conditions of the lungs, pleura and pericardium. Normally, the average excursion of the dependent half of the diaphragm in this series of cases was 6.3 cm.; of the upper half 3.8 cm. The average difference in favor of the lower segment was 2.5 cm. Excursions of the upper leaf smaller than 2.5 cm., of the lower leaf smaller than 4.5 cm., or a difference between movements of the two

segments of less than 1.5 cm. are to be considered pathological. However, when each one of the four measurements in a set exceeds 4.5 cm., the action of the diaphragm is to be considered normal. Normally, the brightest illumination of the lungs on inspiration occurs at the base of the dependent lung. Deviation from this represents lesions in the lung. When the excursion of one segment of the diaphragm is much restricted in both lateral positions, pleural adhesions on the side of the restricted leaf are indicated. When the movements of both sides of the diaphragm are much restricted in one lateral position and are normal in the other, this restriction indicates abnormality of the lower lung in the position showing the restricted movement. Normally, the heart moves away from the dependent chest wall on deep inspiration, the movement of the lower border of the heart shadow being greater than that of the upper border. In patients with adherent pericardium, this movement of the heart upward on inspiration is restricted or absent.—*E. P. Pendergrass.*

Cohn, Max. The question of mobility and motility of the vermiform appendix. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 26–38.

There is considerable disagreement among pathologists with regard to the motility of the vermiform appendix. After a short discussion of the different theories, Cohn describes his own observations. He does not think that a simple roentgenoscopic examination can give much valuable information with regard to the mobility or motility of the appendix. However a careful analysis of serial roentgenograms taken at different intervals shows that the motility of the vermiform appendix resembles more that of the colon than that of the small intestine. The circular contractions and the tonic contraction rings simulate the haustral segmentation of the colon. From an observation of two small shot in the appendix over a period of several months, Cohn thinks that the appendix is able to perform marked peristalsis, but that this resembles more a passive than an active motion.—*T. Leucutia.*

Coryllos, Pol N., and Birnbaum, George L. Lobar pneumonia considered as pneumococcic lobar atelectasis of the lung. *Arch. Surg.*, Jan., 1929, xviii, 190–241.

Coryllos and Birnbaum in a most excellent presentation give clinical and experimental evidence to support their premise that lobar pneumonia is probably and should be termed pneumococcic atelectasis. They review the theories of pneumonia, present experimental data with complete protocols, discuss the etiology, pathogenesis, pathology and roentgen observations. They suggest that the treatment of pneumonia should include early bronchoscopic drainage of the affected lung.

Their conclusions are: A new conception of pneumonia has been presented, based on experimental and clinical data. Lobar pneumonia is considered as an "infectious (generally pneumococcic) lobar atelectasis of the lung." Postoperative massive atelectasis, postoperative pneumonia and "lobar pneumonia" are shown to have a similar pathogenesis and evolution, and clinical and roentgen signs. Bronchopneumonia is considered as an infectious patchy atelectasis. Bronchoscopic treatment, which has given such encouraging results in massive atelectasis, has been suggested and applied to cases of lobar pneumonia in man. The number of cases is as yet too small to allow definite conclusions to be drawn from them.
—*E. P. Pendergrass.*

Daily, Louis, and Daily, Ray K. Diagnosis and treatment of dacrocystitis. *Am. J. Opth.*, Jan., 1929, xii, 1–10.

The authors consider that disease of the lacrymal sac belongs definitely in the sphere of the opthalmologist, who should make the diagnosis, decide on the treatment, and depend on the rhinologist only for the performance of the operative technique.

Diagnostic procedures include the introduction of fluorescin into the eye, irrigation with non-irritating solutions, and roentgenography. The authors condemn probing as painful and not devoid of danger. They consider roentgenology accurate as well as painless.

The technique of making the roentgenograms is explained in some detail. Lipiodol is to be preferred if the injection can be made on the roentgen table, and bismuth paste if the patient must go some distance to the roentgen laboratory. The injection is made with a lacrymal needle and Luer syringe after irrigation of the lacrymal sac; 0.25–0.50 c.c. proves sufficient in all cases. Films are made with the patient's head in occipitofrontal and lateral positions. A number of roentgenograms are reproduced illustrating several different conditions thus demonstrated.

The lacrymal passages may be divided into a horizontal part (canaliculi) and a vertical part (sac and duct). Normal roentgen findings in cases of epiphora eliminate pathology in the vertical portion (sac and duct) and restrict the zone of possible disease to the horizontal portion. If stenosis is shown by the films in some portion of the vertical division of the lacrymal apparatus, dacrocystitis will surely

develop if it is not already present. Active treatment should be started at once in order to prevent the onset of serious complications.

Before resorting to surgery, one may try treating the sac with Besredka's bacterial filtrates prepared from pneumococci and streptococci; 50 per cent cures are claimed for this method of treatment, leaving still 50 per cent to be operated upon.

In adults the procedure indicated is the intranasal drainage of the sac, in front of the middle turbinate. This is preferable to extirpation of the sac because physiological function is restored and postoperative epiphora does not result. The authors prefer the Halle-West operation and describe it in considerable detail in relation to the anatomical structures of the nose. They use general anesthesia in children and a combination of morphine and hyocine with local cocaine in adults. It is thought best to remove as much of the sac as possible at the time of operation.

The results of this type of intranasal surgery have been very good, the percentages of cures reported ranging from 60 to 90 per cent. Three cases—all making excellent recovery after intranasal drainage and resection of the sac—are reported by the authors.—*R. S. Bromer.*

Erdélyi, Josef. Diagnostic interpretation of the roentgen changes in pituitary tumors. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 280–298.

The material includes 35 cases.

Method of examination. One film with the central ray directed over the sella turcica, in right and left lateral positions; stereoscopic films of the entire skull in lateral position and one film in the occipitofrontal direction.

The cases are divided into three main groups: (1) Tumors associated with acromegaly—14 cases. Positive roentgenologic findings were observed in connection with skeletal changes produced by the acromegaly and the pressure changes produced in the sella turcica by the expanding tumor. The acromegalic changes were evident in all face bones, there being a marked hyperostosis, and a very marked enlargement of all the sinus spaces. The sella turcica showed enlargement both in length and depth; while the opening of the sella has often maintained a normal size. The posterior clinoid process and the dorsum sellae were in some cases eroded but as a whole these changes were slight. The anterior clinoid processes were normal in 9 cases and eroded in 4 cases. The sphenoidal sinus was narrowed and flattened. There was evidence of a periosteal bone deposit on the floor of the sella probably due to irritative changes from the stasis produced by the expanding tumor.

(2) Pituitary tumors without acromegaly—19 cases (9 intrasellar, 7 extrasellar and 3 unclassified). The positive roentgen findings observed in this group were principally in connection with the sella turcica and in some cases with the secondary changes produced by increased intracranial pressure.

The changes observed in the sella turcica were those of destruction. There was a marked enlargement of the entrance of the sella with increase in the longitudinal diameter. The posterior clinoid processes were destroyed in all cases, with the exception of one. The dorsum sellae was destroyed in 17 cases and the anterior clinoid processes in 11 cases. The changes in the sphenoidal sinus were relatively slight.

Although there were clinical symptoms pointing to increased intracranial pressure in several cases, the roentgen findings were positive in only 4. In some instances there was a calcification in the region of the sella corresponding to the tumor.

(3) Pituitary tumors with dwarfism—2 cases. Both tumors were intrasellar and the roentgen changes observed in connection with the sella turcica were identical with those of pituitary tumors with acromegaly.—*T. Leucutia.*

Esau. Extensive symmetrical malacia in the region of the carpal bones. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 381–383.

A case of extensive symmetrical malacia in the region of the carpal and metacarpal joints is described in a man seventy years of age. No changes were observed in the tarsal bones. No cause was found explaining the malacia and the author believes that spinal lesions ought to be taken into consideration.—*T. Leucutia.*

Foerster, Alfons, and Lebermann, Ferdinand. A simple method of cholecystography with sodium cholate and felamin. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 104–107.

A new and simple method of cholecystography is presented, the basic principle of which is the examination of the gall-bladder function by means of cholagogue and choleretic drugs. The method of procedure is as follows: The patient receives the night before the examination six tablets of felamin (cholic acid—hexamethylentetramin). On the morning of the examination, between 6 and 6:30 a glass of milk is taken and an enema is given. Between 7 and 7:30, first 1 gm. of sodium

cholate solution, then slowly and cautiously iodotetragnost solution, and finally again sodium cholate solution is injected. In order to prevent thrombosis it is advisable to add saline solution as recommended by Geiger.

Roentgenograms are then taken two to three and three to four hours after the injection. Due to the cholagogue and choleretic effect of the felamin and sodium cholate the gall-bladder fills three to four hours sooner than would be the case with intravenous injection of iodotetragnost alone. Also the emptying of the gall-bladder follows sooner. Thus the whole method of examination is considerably accelerated, the duration of the examination being reduced to half.—*T. Leucutia.*

Freund, Ernst. Genu varum arthriticum; a typical form of arthritis deformans. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 332–338.

The author describes a case of arthritis deformans with destruction of the cartilages of the internal condyle of the femur and of the tuberosity of the tibia resulting in a genu varum. Attention is called to the periosteal deposits in the neighborhood of the destroyed cartilage such as is observed in arthritis deformans. Following the operation, the resected knee showed a complete destruction of the cartilage of the involved area. The condition is somewhat similar to that of Perthes' disease observed in pituitary disturbances; although since there are no signs of endocrine disturbances in this particular case the author thinks that it remains for the future to clear up the histogenesis of the process.—*T. Leucutia.*

Friendenwald, Julius, Feldman, Maurice, and Zinn, Waitman F. Peptic ulcer of the esophagus. *Am. J. M. Sc.*, Jan., 1929, clxxvii, 1–14.

Peptic ulcer of the esophagus resembles a similar affection in the stomach and duodenum. It is rare but occurs sufficiently often to be of clinical interest. Tilleston states that the following ulcerative conditions must be excluded before a diagnosis of peptic ulcer can be made: (1) carcinomatous; (2) due to action of corrosive substances; (3) due to foreign bodies; (4) occurring in the course of acute infectious diseases; (5) decubitis; (6) due to aneurysm; (7) catarrhal; (8) due to traction diverticula; (9) tuberculous; (10) syphilitic; (11) varicose, and (12) due to thrush.

The recognition of peptic ulcer is of comparatively recent date though isolated cases reported back as far as 1839 have been reported by Albers.

Patbology. Peptic ulcers of the esophagus are usually observed in the lower third of the esophagus though occasionally they are located higher. When situated low they rarely extend into the stomach. The size of the ulcers varies greatly from small up to 8–10 cm. in length. The small ulcers are usually round, the large are often irregular. The ulcers are usually single but may be multiple, and they are usually located on the right posterolateral wall. The ulcer may be superficial or it may be deep; if superficial, the edges are clean cut, if deep, the edges are undermined and the base, funnel shaped. The healing takes place by scar formation which in the case of the large ulcers may lead to stenosis.

Etiology. Same as that in peptic ulcer of stomach and duodenum. Diseases in which vomiting or regurgitation of food occur play an important rôle. In order that this affection may occur the cardia must remain patent, so that the regurgitated acid gastric secretion may continue its corrosive effect upon the localized diseased area in the esophagus.

The ulcerations have been most frequently observed in adults the condition being most common between the thirtieth and seventieth years, but it has been observed in children.

Symptoms. The disease usually runs a latent course. The prominent symptoms are pain, dysphagia, vomiting, hemorrhage and perforation.

Diagnosis. There is usually great difficulty in arriving at a diagnosis and not uncommonly the diagnosis is not made until a fatal complication such as hemorrhage occurs. The roentgen examination and the esophagoscope are the best aids to diagnosis.

The subject is roentgenoscoped in the anteroposterior, lateral and oblique positions, utilizing barium and water or acacia as a medium. Four types of defects are found: (1) Mucosal erosions, (2) niche or penetrating, (3) spastic defects, (4) perforating.

The spastic defects may be (1) simple transient spastic defects causing retardation of the opaque meal; (2) a tapering defect of the esophagus toward the cardia; (3) an indentation, resembling an incisura opposite the ulcer.

The disease may last a few days to several years, usually the average is six months. The treatment consists in removal of focal infection, rest, diet, local applications, etc. Thirteen cases are reported.

—*E. P. Pendergrass.*

Frik, K., and Blühbaum, Th. A new method of application of colloids in roentgen diagnosis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 1111–1119.

The author presents his observations in about 100 cases following the administration of "tordiol," an opaque colloidal substance (the chemical formula of which is thorium hydroxydhydrosol). The substance has proven entirely innocuous and has many advantages when applied to the roentgen examination of the colon and female genitalia.

The advantages of tordiol over barium sulphate in the study of the colon are: (1) since tordiol is soluble in water it can be employed in cases where barium is contraindicated or where it cannot be employed for other reasons; (2) a very simple technique permits the demonstration of the folds of the intestinal mucosa at the same time. As a rule, 500 to 700 c.c. of a 20 per cent solution is used in the form of an opaque enema. The roentgenogram should be taken within twenty minutes after the enema is given.

In uterosalpingography tordiol is used in the same manner as iodized oil. It is very important that serial roentgenograms should be made.

The application of tordiol was also tried in cystography with satisfactory results. Especially is it possible to demonstrate the rugae of the mucosa of the bladder. It can be used also in strictures of the urethra and in skin fistulae to good advantage. In pyelography as well as in bronchography tordiol is contraindicated.

—*T. Leucutia.*

Gaugele, K. The prognosis of scoliosis. *Arch. f. klin. Chir.*, 1928, cliii, 571–593.

It is customary to differentiate three phases in the development of scoliosis: (1) scoliosis due to muscular debility without bone changes; (2) fixed scoliosis with beginning bone changes, and (3) fixed scoliosis with advanced bone deformities. The author distinguishes sharply between the first stage which he calls non-fixed scoliosis due, as a rule, to bad posture, and the second and third stages which he calls contracture, or more accurately, rachitic contracture of the spine. Since scoliosis due to bad posture can be readily cured by specific treatment, it is important that this be recognized early. The method practiced until now in taking roentgenograms in the upright position in order to determine the curvature of the spine is not sufficient since a scoliosis due to bad posture may easily be confused with a beginning contracture of the spine. Therefore the author advocates that a roentgenogram be taken in the horizontal position by applying extension on the arms and feet during exposure. The advantages resulting from such a procedure are self-evident both with regard to prognosis and therapeutic indications of scoliosis. The following criteria are especially taken into consideration: (1) scoliosis due to bad posture is corrected in the horizontal extension roentgenogram so that a straight alignment of the spine, a normal position of the pelvis and a symmetry of the two halves of the thoracic cage are observed; (2) if the horizontal extension roentgenogram indicates the slightest scoliotic changes a beginning contracture is present. The asymmetry of the two halves of the thoracic cage is here of especial importance since it indicates a torsion of the spine along the longitudinal axis. The torsion may be confined to the entire spine or to parts of it; (3) in the advanced cases, in addition to the scoliotic or torsion contracture, there is a marked bone deformity present.

With regard to the prognosis the horizontal extension roentgenogram may furnish the following data: (1) In cases of pronounced external scoliosis the negative findings of the horizontal extension roentgenogram indicate a good prognosis, a rational general treatment, especially in the way of massage and gymnastic exercises, leading to excellent results. (2) In cases where the horizontal extension roentgenogram shows even the slightest torsion of the spine or asymmetry of the two halves of the thoracic cage, a beginning contracture is evident and if treatment is started immediately the progress of the disease can be controlled. (3) All cases with a definite contracture whether or not this be of scoliotic character or torsion are to be considered incurable. A systematic treatment (gymnastic exercises, massage, supporting apparatus, etc.) over a period of years, however, may lead to arrest of the disease. (4) An exception is formed by rachitic scoliosis during the active stage of the disease where good results are often obtained even in cases with advanced deformities.—*T. Leucutia.*

Göttche, O. The roentgen diagnosis of bronchotetany. *Arch. f. Kinderh.*, 1928, lxxxv, 185–194.

Bronchotetany was first described fifteen years ago and since that time only a very few cases have been reported in the literature. The author recently observed a typical case and was able to obtain roentgenograms in the different phases of the disease. The condition is characterized by a sudden spell of expiratory dyspnea such as observed in asthma, but the roentgenogram taken immediately after the onset of the attack shows a picture which simulates that of pneumonia. There is a partial opacity of one of the upper lobes such as would be seen in a beginning lobar pneumonia. The author immediately instituted calcium therapy and under the influence of the treat-

ment the attack disappeared within twenty-four hours. A roentgenogram taken at that time showed that the process in the upper lobe had also cleared up. A few weeks later the patient had a second similar attack and roentgenograms then taken showed identical findings. From this the author arrives at the conclusion that bronchotetany is a spastic contraction of one of the main bronchi probably due to irritation—in the case mentioned, from enlarged tuberculous peribronchial lymph nodes—and resulting in a partial atelectasis of the lung.—*T. Leucutia.*

Habliston, Charles C. Intrapleural pressures in massive collapse of the lung. *Am. J. M. Sc.*, Dec., 1928, clxxvi, 830–837.

Habliston reports 4 interesting cases of massive collapse of the lung or apneumatosis as he prefers to call it. He reviews some of the literature and tabulates the causative factors and the physical and roentgenological signs. His paper, however, deals mainly with intrapleural pressure in massive collapse. He found a marked increase in the intrapleural negative pressure in each case. He believes that this is a constant finding in massive collapse and is directly responsible for the physical findings of cardiac displacement and is the factor underlying the symptoms of dyspnea and cyanosis. Partial artificial pneumothorax which reduces the negative pressure to within normal limits has given immediate symptomatic relief.
— *E. P. Pendergrass.*

Heuer, George J. Thoracic tumors. *Arch. Surg.*, Jan., 1929, xviii, 271–282.

Heuer gives a summary of the different types of thoracic tumors, attempting to bring the subject up to date. He states that accurate classification of the tumors is almost impossible because of insufficient data. His research has convinced him of the advisability of a thoracic tumor registry such as the Registry of Bone Sarcoma, in order that a large collection of the tumors may be made and studied. He has presented and divided the tumors into various groups which include those arising from the bony thorax, mediastinum, lung and pleura.—*E. P. Pendergrass.*

Hilpert, F. The pneumo-relief of the stomach. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 80–87.

The classical Rieder meal is no longer sufficient for the roentgen diagnosis of the gastro-intestinal tract. Forssell demonstrated that the folding of the mucous membrane of the stomach observed in the roentgenogram is not the result of the longitudinal and transverse musculatures of the stomach but that it represents formations resulting from the active movements of the muscularis mucosae itself. There can be no doubt that the typical form of the mucous membrane relief is regulated through hydrodynamics and by the muscular force of the mucous membrane. That the modifications of the folding of the mucous membrane observed in pathological conditions are likewise due to the active movements of the mucous membranes itself is self-evident. Therefore Hilpert thinks that the demonstration of the folding of the mucous membrane is an important factor in the differential diagnosis of the various lesions of the stomach.

In order to visualize the rugae of the stomach, Hilpert advises preliminary to the usual barium meal, the following procedure: 20 to 30 gm. barium sulphate with 15 gm. of bolus alba is made into a mixture and given to the patient. Following the ingestion of the barium mixture the stomach is slightly massaged. Then 300 to 400 c.c. air is introduced by means of a stomach tube or duodenal sound.

The pneumo-relief method is of especial value in the diagnosis of lesions of the stomach in unusual locations, such as carcinoma of the cardiac end of the stomach or a beginning carcinoma originating from the posterior wall, furthermore in certain cases of pyloric, prepyloric and duodenal ulcer, and, finally, in conditions following a gastroenterostomy.

The author emphasizes that the method should never be used alone but always as an adjunct to the barium meal examination. The clinical symptomatology should also be taken into consideration.—*T. Leucutia.*

Kalkbrenner, H. A new roentgenologic method for the examination of the colon. The visualization of the mucous membrane folding with "umbrathor." *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 325–332.

The present methods of examining the colon are the barium meal, the insufflation, the barium enema and the combination of insufflation with barium enema. None of these methods is of value in demonstrating the folding of the mucous membrane of the colon.

Kalkbrenner introduces a new preparation, the so-called "umbrathor," which is a thorium dioxydsol. The principle of the action is as follows: The mucous membrane of the colon normally produces a secretion containing a considerable amount of biocolloids and electrolytes. Both of these products have the common feature that their colloidal constituents carry on an electric charge depending on the hydrogen ion concentration and the state of the so-called iso-electric point of the medium.

This charge in a neutral and alkaline medium is negative. In a normal mucous membrane because of the uniform distribution of the colloidal secretion the electric charge is more or less uniform. In case of inflammation or ulceration because of the secretion disturbance there is also a disturbance in the distribution of the electric charge. The umbrathor, because of the content in high atomic thorium, forms a positively charged colloidal solution, consequently it neutralizes the negative charge of the biocolloids of the secretion of the mucous membrane and thus coats the mucous membrane, forming a relief picture of the foldings.

The appearance of the normal mucous membrane with umbrathor is different in the various sections of the large bowel. In the rectum the appearance is that of long stripes while in the sigmoid and in the colon as far as the hepatic flexure the appearance is that of a fine network. In the ascending colon the contrast medium shows an ampullar arrangement. In pathological conditions such as inflammation and ulceration this appearance is disturbed. Two cases are presented by the author, one a proctitis and the second a colitis ulcerosa in which the diagnosis was made by the use of umbrathor.

Technique. Great care has to be taken with regard to the preparation of the patient. The evening before the examination a dose of castor oil is administered and the patient is put on a fluid diet. The morning of the examination a lukewarm water enema (1.5 liters) is given and this is repeated just before the examination. It is important that no air be carried into the colon with the enema and that the bowel be entirely empty following the enema since both air and water interfere with the visualization of the relief of the mucous membrane. The roentgen examination is carried out on an empty stomach. Three hundred to 400 c.c. of the preparation are injected into the colon by means of an irrigator which has been previously rinsed with distilled water. During the injection the patient is placed in an elevated pelvic position until the contrast medium has reached the splenic flexure; then the patient is placed on the right side until the solution has reached the region of the cecum. It is advisable to slightly massage the abdomen in order to facilitate the passage of the contrast medium. Five to ten minutes are required to inject the contrast medium and it is necessary that the solution should be left in contact with the bowel for five to ten more minutes. The bowel is then emptied and roentgenograms are taken.

The author believes that the method will become of practical value especially in the demonstration of lesions producing disturbance in the structure of the mucous membrane.

—*T. Leucutia.*

Kernan, John D., and Cracovaner, Arthur J. Carcinoma of the lung. *Arch. Surg.*, Jan., 1929, xviii, 315–328.

The authors report a case of carcinoma of the lung which was treated successfully by surgical diathermy and implantation of radium directly into the growth occupying the left bronchus. The treatment was given by means of the bronchoscope. Prior to the institution of the treatment the patient had recurrent attacks of atelectasis with evidence of bronchiectasis in the left lower lobe.—*E. P. Pendergrass.*

Kingreen, Otto. Experiences with cholecystography. *Arch. f. klin. Chir.*, 1928, cliii, 113–122.

The following methods were tried out: The peroral administration of sodium tetrabromphenolphthalein, the rectal or duodenal administration of tetrabromphenolphthalein and the intravenous administration of tetraiodophenolphthalein. The best results were obtained by the intravenous method. Contraindications are: arteriosclerosis, diabetes, endocrine disturbances and hyperthyroidism. The following classification is made of the results obtained: (1) good filling of the gall-bladder indicating normal conditions; (2) non-filling of the gall-bladder even after atropine injection, indicating obstruction; (3) slight filling of the gall-bladder which can be considered diagnostic only in conjunction with other clinical and anamnestic signs; (4) deformities, double formations, etc., of the gall-bladder indicating anomalous development; (5) evidence of gallstones, the cholesterin stones which remain undetected by simple roentgenography being especially well brought out.

It is advisable to combine cholecystography with roentgen examination of the stomach, duodenum and pyelography in order to eliminate conditions arising from these organs.—*T. Leucutia.*

König, Ernst. On the so-called "streak" formation in the pyelogram. *Beitr. z. klin. Chir.*, 1928, cxliv, 320–335.

Several communications have recently appeared in the literature dealing with streak formation in pyelograms. The phenomenon is observed in the majority of cases at the poles of the kidney, or less frequently in the mid-portion of the kidney, either single or multiple.

In examining the pyelograms of 128 cases

one single case of streak formation was found in a boy seventeen years of age. In connection with this case the author undertook a series of experiments in order to determine whether the streak formation is due to the entrance of the contrast solution into the venous system of the kidney, so-called pyelovenous reflux, or whether the contrast solution has entered the parenchyma of the kidney through the uriniferous canals. The experiments were carried out principally on dogs. After the opening of the bladder by the abdominal route the catheters were introduced into both ureters as high as the kidney pelvis and then the bladder and abdomen closed. In order to eliminate all disturbance from motion during the exposure, the animals were anesthetized and then 2 c.c. umbrenal solution injected. Roentgenograms were taken and then 2 to 6 c.c. additional contrast solution injected under rather fast pressure. Again roentgenograms were taken. After this the animals were killed and the kidney examined microscopically. As a rule fifteen to thirty minutes elapsed between the pyelography and microscopic examination of the kidneys.

As a result of these investigations it was found: (1) that if an overfilling of the kidney pelvis was produced by applying a rather high pressure, the entrance of the contrast solution into the uriniferous canals resulted; (2) in applying colored umbrenal as contrast medium under similar conditions an experimental streak formation was observed. The streak formation consequently must be due to the entrance of the contrast medium into the uriniferous canals.—*T. Leucutia.*

Laurell, Hugo. The manometer as an aid in obtaining sharp roentgenograms in organs moving during respiration. *Acta radiol.*, 1928, ix, 478–481.

The author applies a simple water manometer during the roentgen exposure of organs which move with respiration such as lungs, kidneys and gall-bladder. The patient blows into the manometer raising the water column to 10 c.c. in ordinary cases and 10 to 20 c.c. in cases where the heart action is to be registered, and holds the pressure at the indicated point for ten to fifteen seconds while the roentgenogram is being taken. The advantages of such a procedure are: (1) that through the blowing the patient is more apt to keep still during the exposure; (2) that if it is desired to compare roentgenograms at intervals, they can be taken with the same pressure giving thus more nearly identical conditions, especially in the examination of the lungs.—*T. Leucutia.*

Lenk, Robert. The significance of artificial pneumothorax in the diagnosis of intrathoracic, especially mediastinal, tumors. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 88–91.

Pneumothorax as a diagnostic test in intrathoractic tumors has been repeatedly advocated but only rarely carried out. Lenk considers the differential diagnostic value of pneumothorax in lung and mediastinal tumors and arrives at the conclusion that in lung tumors the method is of very little value. It is true that in exceptional cases a diagnosis was made by the aid of pneumothorax (the case of Assmann is especially cited in this respect), but as a rule the method is not of particular value. In mediastinal tumors conditions are somewhat better. The author describes a case in detail where a diagnosis was made only after an artificial pneumothorax was produced. Here the differentiation between a mediastinal tumor and a primary carcinoma of the bronchus or other lung affections was considered.

—*T. Leucutia.*

LeWald, Leon R. Roentgenologic diagnosis of thoracic dermoids. *Arch. Surg.*, Jan., 1929, xviii, 300–306.

The term dermoid is used rather than teratoma because the majority of the cases are benign, and only become dangerous because of size.

In some instances the tumors are closely associated with the mediastinum and offer considerable difficulty in differentiation from aneurysm. LeWald stresses the fact that even to the experienced it is hard to differentiate between expansile and transmitted pulsation in some of these cases. The differential diagnosis between intrathoracic dermoid and a primary or secondary malignant growth is sometimes difficult. The slowness of growth of a dermoid or an operative procedure may be the only available means of actually determining the type of lesion. He states that intrathoracic dermoids are more common than was believed prior to routine roentgen examination of the chest. The early roentgenologic recognition of the dermoid allows the thoracic surgeon a chance to deal successfully with the lesion. Examination of patient in various positions is necessary to identify the lesion.

—*E. P. Pendergrass.*

Lewin, Philip. Epiphyses: their growth, development, injuries and diseases. *Am. J. Dis. Child.* Jan., 1929, xxxvii, 141–178.

The author summarizes the present knowledge of epiphyseal growth, development,

injuries and diseases. In discussing the normal epiphyses, he states their functions as follows: (1) to serve in the formation of joints; (2) to serve as attachments for muscles and tendons, and (3) to develop the length of bones. The types of epiphyses are the following: (1) pressure epiphyses, which are found at the ends of long bones and transmit the weight from one bone to another; (2) traction epiphyses which serve as attachments for muscles, and (3) atavistic epiphyses which represent parts of the skeleton which have lost their function. Traction epiphyses were originally sesamoid structures though not necessarily sesamoid bones.

Epiphyseal union and age are discussed, Lewin quoting largely from the work of Pryor and Stevenson. He quotes the conclusion of the latter that accurate determination of age depends on the correlation of the stages of union found in the various bones rather than on the condition in any single portion of the skeleton. The blood supply of the epiphyses is obtained from the network of periosteal arteries, branches of which perforate the compact bone to be distributed throughout the cancellous bone independent of the diaphyseal blood supply. Rarely more than one or two small arteries pass over into the epiphyses from the diaphyses; this fact accounts for the infrequent occurrence of necrosis of the epiphysis when the diaphysis is more or less completely displaced from the epiphysis.

The factors which affect the epiphyses are: heredity, circulatory changes, trauma, infection, diet, ultraviolet rays, exercise or muscular effort, fresh air, endocrine disturbances, obesity, chemicals, massage, roentgen rays and radium. He briefly summarizes the work of different authors on the circulatory, infectious and the traumatic theories of the causation of osteochondritis in the various epiphyses, quoting at some length the work of Bergmann that an aseptic necrosis, either alone or associated with another pathological condition, is the essential factor in the etiology of this group of bone diseases.

The disturbances of the various epiphyses are then individually discussed, namely osteochondritis deformans coxae juvenilis, or Legg-Calvé-Perthes' disease, Osgood-Schlatter's upper tibial epiphysitis, osteochondritis of the upper and lower extremities of the tibia and of the lower end of the fibula, apophysitis of the os calcis, Köhler's tarsal scaphoiditis, juvenile deforming metatarsophalangeal osteochondritis or Freiberg's infraction of the metatarsal head, osteochondritis of the base of the fifth metatarsal bone, vertebral epiphysitis of Calvé, Scheuermann's kyphosis dorsalis juvenilis, and osteochondritis deformans juvenilis of the shoulder joint. Theories of causation, differential diagnosis, roentgen-ray appearance, and treatment of each condition are described. In addition coxa vera luxans, acute and chronic infectious epiphysitis, traumatic epiphysitis, and avulsion of the lesser femoral trochanter, and of the epiphysis of the tuberosity of the ischium, are more briefly discussed. Kienböck's carpal scaphoiditis is also briefly defined. Mention is made of a case previously reported by the author in which on the roentgenogram an appearance of an epiphysis within an epiphysis was presented, which was explained on the basis of a two-stage growth of the epiphysis.

It is a well-known fact, according to the author, that in cases of fractured femurs in children, equalization of the length of the legs occurs. At the end of one or two years the fractured, shortened legs become practically as long as their injured mates. He emphasizes this fact as being of extreme importance in limitation of further operative interference in such cases of fracture.

Glandular disturbances which involve the epiphyses are epiphyseal coxa vara or epiphyseolysis, cretinism, infantilism, gigantism, dwarfism, and midgetism, hypogonadism and eunuchoidism. The two latter consistently show a definite late fusion of the epiphyseal ends of the long bones. This late closure of the epiphyseal ends of the long bones has also been found in cases of primary deficiency of the anterior lobe and a secondary deficiency of the generative organs.

Under miscellaneous conditions affecting the epiphysitis of the jaw, osteochondritis of the olecranon process, patella cubiti, Panner's disease, (premature ossification of the metacarpal bone) and osteochondritis of the ischiopubic region are mentioned. In Still's disease, rickets of the adolescent type, infantile paralysis, and coccidioidal granuloma the epiphyses show definite changes.

As an encyclopedic summary of this subject this article is well worth reading.

—*R. S. Bromer.*

Lilienthal, Howard, and Amberson, J. Burns. Unilateral pneumothorax. *Arch. Surg.*, Jan., 1929, xviii, 533–541.

The authors report the results of their studies in unilateral pneumothorax, closed and open.

In pneumothorax with an external opening, blowing exercises tend to inflate the collapsed lung and to force the mediastinum toward the open side. In closed pneumothorax, blowing exercises tend to compress the collapsed lung, and the mediastinum is forced toward the

healthy lung which is also compressed. In pneumothorax with an external opening, straining with the closed glottis deviates the mediastinum to the open side and expands the collapsed lung. In closed pneumothorax, straining with the closed glottis produces little or no deviation of the mediastinum. In closed pneumothorax, forced expiration tends to rotate the heart and its attachments. In roentgenologic study of pneumothorax, closed or open, observations and records should be made in deep inspiration, in full expiration and in straining against the closed glottis.

—*E. P. Pendergrass.*

Lyon, Ernst. Epiphyseal fractures of the bodies of the lumbar vertebrae in childhood. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 376–380.

A case of a boy seventeen years of age is presented who suffered an accident to the spine in 1926 and appeared for examination two years later complaining of pain in the back. The roentgenogram showed hypersclerosis of the dorsal spine with fracture of the bodies of the third and fourth lumbar vertebrae. Since the fractures occurred about two years following the accident, the author thinks that they rather represent an aseptic necrosis of the epiphyses of the bodies of the lumbar vertebrae, resulting in a pathological fracture.

—*T. Leucutia.*

Mayer, Ernst G. On application of ascending iodized oil in roentgen diagnosis of certain brain lesions. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 619–622.

On the basis of his own observations and after a critical study of the literature, the author analyzes the applicability of ascending iodized oil in the roentgen diagnosis of certain cerebral lesions.

The reaction due to the injection of the ascending lipiodol is sometimes very pronounced. According to Sgalitzer (observations on 73 cases) in one-third of the cases no symptoms, in another third intensive headaches lasting from one to three days and in another third very intensive headaches lasting for several days are produced. Also nausea, elevation of temperature, hyperasthesia of the skin is observed and in 2 cases there was meningismus and stiff neck for a period of two days. One case came to exitus and the post-mortem examination revealed evidence of sterile meningitis. Albrecht observed also the occurrence of a painful paralysis of the nerves of the eye muscles.

The advantages from injection of the ascending lipiodol are: (*a*) that a differential diagnosis between hydrocephalus communicans and hydrocephalus occlusus is possible: (*b*) that in case of a destruction of the sella turcica differentiation can be made between a pituitary tumor and a hydrocephalus as a cause of the destruction, and (*c*) that the ventricles can be well outlined. In discussing the value of these differential diagnostic criteria, the author, however, arrives at the conclusion that they cannot be applied in all instances and that errors are possible.

The disadvantage of the method is that there is a very slow absorption of the injected iodized oil so that sometimes several years later the presence of iodized oil acting as foreign body within the brain tissues can be demonstrated. For this reason once an injection of ascending iodized oil has been done a repetition of the examination cannot be carried out for a period of several years.—*T. Leucutia.*

Michailow, Mich. The roentgen appearance of bone changes in Beck's disease (osteochondro-arthrosis deformans endemica). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 364–367.

Four cases of Beck's disease are reported showing typical roentgen evidence of bone changes. These changes consist especially in the narrowing of the joint spaces, the partial or complete destruction of the cartilage of the joint surfaces resulting in bone deformities. There is a porous change within the bone structures, there being a sharp differentiation between the corticalis and spongiosa; there is also an early ossification of the epiphyseal lines with resulting irregularity and deformity of the epiphyseal ends.

The author thinks that these changes are due to inner secretory disturbance. On the basis of clinical examination a hypofunction of the thyroid gland and a diminishing in the calcium content of the organism was observed.

—*T. Leucutia*

Miller, T. Grier, Pendergrass, E. P., and Andrews, Katherine S. A statistical study of clinical and laboratory findings in gastric and duodenal ulcer, with special reference to roentgenologic data. *Am. J. M. Sc.*, Jan., 1929, clxxvii, 15–33.

The clinical and laboratory data on 279 operatively proven gastric and duodenal ulcer cases representing a ten-year experience in the University Hospital, are analyzed, special attention being given to a selected group of 36 gastric and 100 duodenal cases. The duodenal outnumbered the gastric cases in a ratio of 4 to 1, and it is pointed out that for all of those presenting symptoms the duodenal pre-

ponderance is even greater. The male sex predominated in each group (85 to 90 per cent) and the women were on the average a little less than the men. Aside from the roentgen findings, the history was of greatest diagnostic importance and sometimes afforded evidence suggesting gastric or duodenal localization of the lesion. The physical examination was of less diagnostic importance. Both groups of cases showed a tendency to high gastric acidity, more marked in the duodenal, but it is emphasized that such high acidity may occur in individuals free of all evidence of disease and so in itself cannot be accepted as evidence of ulcer.

The roentgen diagnosis was correct in 94 per cent of the gastric and 88 per cent of the duodenal ulcers. The most important roentgenologic diagnostic sign was the filling defect. In 23 cases which were diagnosed as either pyloric stenosis, gastroduodenal ulcer or pyloric obstruction, only 6 ulcers seemed to be pyloric in origin, the others being distinctly duodenal. Healed ulcers give filling defects similar to adhesions or ulcer, but do not have associated suggestive roentgenoscopic phenomena.

—*E. P. Pendergrass.*

Møller, P. Flemming. Congenital thoracic cysts and lung deformities in the roentgen picture. *Acta radiol.*, 1928, ix, 460–473.

The author describes a case of congenital mediastinal cyst where the diagnosis was made by roentgen examination. The patient was operated upon with very satisfactory results. In connection with this case the author reviewed the subject of congenital cyst formations within the thorax and was able to collect 5 more cases which were also diagnosed roentgenologically.

The congenital cysts most frequently occurring within the thorax are bronchogenic cysts, dermoid cysts and teratomata arising from the anterior mediastinum. A clinical examination in such cases is of no value. Roentgenography forms the sole procedure; however, even here a differential diagnosis from aortic aneurysm, retrosternal struma, mediastinal tumors, abscess of the anterior mediastinum and echinococcus cysts often is very difficult. The diagnosis in most instances was made by exclusion. A very important point is the paucity of clinical symptoms as compared with the findings on roentgen examination. The cases examined all showed single or multiple cavities of various sizes irregularly arranged, with sharp delineation and without any reaction in the neighboring pulmonary tissues.

—*T. Leucutia.*

Orosz, Dezsö. An accurate localization of an intrathoracic cyst in an infant by means of pneumothorax. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 371–373.

A case of large intrathoracic cyst is described in an infant eleven months of age. An accurate localization of the cyst was obtained by injecting 200 c.c. of air into the right thoracic cavity. The apex and the hilus were free. An operation revealed that the cyst contained parts of gastric mucosa and gastric glands. It is possible that the cyst originated through encroachment on the mucosa of the gastrointestinal tract during embryological life.

—*T. Leucutia.*

Reid, William D. Comparsion of the electrical axis shown by the electrocardiogram with roentgen mensuration of the heart. *Am. Heart J.*, December, 1928, iv, 223–226.

Deviation of the electrical axis in the electrocardiograms is an unreliable means of determining hypertrophy of one or the other ventricle. Axis deviation was compared with roentgen measurements in 100 consecutive cases. The indications of cardiac enlargement were found to agree in 67 cases, to disagree in 23 and to be questionable in 10. In most of the cases in which the results were at variance, the numerical value of the electrical axis indicated a deviation to the right or left although the roentgen ray disclosed a normal-sized heart. The electrical curves do not disclose enlargement of the heart; one ventricle must be enlarged out of proportion to the other. In 7 of the 9 cases in which the roentgen ray showed an asymmetrical enlargement of the heart, the electrocardiogram showed deviation of the electrical axis. In only 7 of the 29 cases of axis deviation did the roentgen examination disclose an enlarged heart. In the 35 cases in which one or the other method indicated enlargement, the two agreed in only 23 per cent.

The author does not give the technique of the teleroentgenograms and does not indicate how the presence or absence of cardiac enlargement was estimated in the individual cases.

—*R. Golden.*

Rosenhagen, Hans. On certain relations between the histological changes and roentgen findings in chronic passive congestion of the lung. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 353–359.

Three cases are described. Histological examinations of the lungs following postmortem showed passive congestion of the lung with circumscribed areas of heart failure cells.

The roentgenograms showed that these circumscribed areas were visualized in 2 cases as a fine mottling such as observed in tuberculosis, and in the third case as a fine marbling of the lung involved. Emphasis is laid on a possible confusion with tuberculosis in such cases.

—*T. Leucutia.*

Rummel, Hans. A rare, also roentgenologically noteworthy cause of backache (beak formation from spondylitis typhosa). *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 348–353.

The author describes a bony union of the second and third lumbar vertebrae in a girl seventeen years of age who was operated on for a painful retroflexion of the uterus. There was a marked decrease in the intervertebral spacing with destruction of the disc and with bony changes of the adjacent surfaces of the vertebrae. In places there was fusion of the bony structures of the two vertebrae more pronounced at the margins. There was evidence of considerable bone deposit. The condition closely resembles that of spondylitis typhosa.

—*T. Leucutia.*

St. Dedić. The profile of mitral stenosis and mitral configuration of the heart. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 68–79.

The author describes the orthodiagraphic findings of mitral stenosis in the sagittal (posteroanterior) position as follows: the size of the heart is normal or there is a slight enlargement of the right heart; the angle between the ascending aorta and right auricle is higher (D angle of Vaquez-Bordet); the aortic arch is flat; the left median arc is formed in the upper end by the conus pulmonalis and in the lower by the left auricle; the line of the left ventricle is rather straight.

A greater advantage results from the examination in the frontal direction (profile). Here there is a rather marked salience of the left auricle and there is a marked reduction of the retrocardiac clear space and enlargement of the right ventricle.

The author then describes the exact values of the different diameters measured in 6 patients with pure mitral stenosis, and in 9 patients with suspected mitral stenosis. In this latter group, in 3 of the cases the heart dimensions in the profile view have corroborated the suspected clinical findings of mitral stenosis, while in 6 of the cases the orthodiagraphic findings have shown a configuration pointing to a mitral lesion.

Some other conditions than mitral lesions, which sometimes simulate the configuration of a mitral heart, are also described. One of the cases was a patient suffering from an early tuberculosis, a second an asthmatic.

From this the author arrives at the conclusion that although the profile orthodiagram is of considerable value and certainly of a greater advantage than the sagittal position in the diagnosis of mitral stenosis, nevertheless the roentgen findings should always be confirmed by clinical and if possible by other methods of examination.—*T. Leucutia.*

Samuel, Max. The diagnostic value of pelvic roentgenograms with a contribution to the diagnosis of sacral pain and hysterosalpingography. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 49–53.

The author advocates that a roentgen examination of the lumbosacral region be made in every instance of sacral pain where no abdominal lesion can be demonstrated. It is advisable to estimate the mobility of the lumbosacral and sacroiliac articulations in comparing roentgenograms in the positions of extreme flexion and extension. It is also advisable that these roentgenograms be made both in anteroposterior and lateral positions. Several of these roentgenograms are reproduced in order to demonstrate that not only the fifth lumbar vertebra but also the lumbosacral ligament as well as the sacrum and the sacroiliac articulation can be visualized. The roentgenograms also permit the study of the intervertebral discs.

By means of other roentgenograms the author emphasizes the importance of hysterosalpingography in sterility and in certain diagnostic cases, especially in extrauterine pregnancy. In instances a differential diagnosis between ascites and ovarian cysts can be made. Stereoscopic roentgenograms taken following the injection of the pelvic organs often made the localization of intratubal tumors possible. They are also of great value in the estimation of pregnancy, especially in determining the relation of the pelvic measurements to the dimensions of the fetal head.

In closing, the author gives a short description of the manometer which he uses to measure the pressure of the insufflation of the tubes, as well as of the oil injection of the pelvic organs.

—*T. Leucutia.*

Schilling, Carl. The indications for artificial pneumothorax with consideration of the modern dual theory and the different stages of pulmonary tuberculosis. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 1–26.

1. History. The first attempt at pneumothorax was made by the Scotch physiologist

Carson in 1822. The method, however, was soon forgotten and not until 1882 did Forlanini and Murphy revive pneumothorax as a systematic therapeutic procedure. The indications for treatment were worked out by Brauer and Spengler in a comprehensive way which still holds good today.

Virchow and Orth have divided pulmonary tuberculosis into productive and exudative forms. This classification was recently reëstablished by Aschoff and his school. Ziegler and Krause were the first to compare the anatomical changes observed in pulmonary tuberculosis with the roentgenographic findings.

II. The histological changes observed in the tuberculous lung under the influence of artificial pneumothorax.

Pneumothorax first produces a compression of the lung with subsequent anemia of the tissues. The poor blood and lymph supply results in a reduced metabolism of the tissues in general and of the pathological tissues in particular. The poor ventilation of the lung influences also the metabolism of the aerobic tubercle bacilli, thus reducing their viability. The compression of one lung results in an increased compensatory function of the opposite lung.

III. The indications for artificial pneumothorax in the different forms of pulmonary tuberculosis (dual theory).

(*a*) Productive form. Neumayer advises the application of pneumothorax only in cases of pulmonary tuberculosis where a conservative treatment has proven of no avail. Gutstein believes that pneumothorax should be used only in early cases of unilateral tuberculous involvement of the lung. Schilling thinks that pneumothorax should be applied not only in the early cases of unilateral tuberculosis but also in the advanced cases where the entire upper lobe may be involved as well as in cases with an early involvement of the opposite lung. Experience shows that the fibrotic process often develops in the opposite lung most probably because of the hyperemia produced by the compensatory function of the expanded lung.

(*b*) Exudative form. Pneumothorax is advised in all cases of primary exudative tuberculosis with unilateral involvement. In the secondary and tertiary stages the condition of the opposite lung should be considered first. If this lung has a normal appearance pneumothorax may be carried out even in advanced cases. Schilling goes so far as to perform pneumothorax even in cases of exudative pneumonic foci.

IV. The indications for pneumothorax in the different stages of pulmonary tuberculosis.

Here roentgen examination is of paramount importance. Schilling accepts Ranke's classification of pulmonary tuberculosis into: (1) localized primary tuberculosis of the lung; (2) secondary generalized; (3) localized tertiary phthisis.

(1) Localized primary tuberculosis. Pneumothorax is indicated in all cases of this stage.

(2) Generalized secondary tuberculosis. Because of the more or less generalized character and exudative type of the disease pneumothorax is possible in only a limited number of cases.

(3) Tertiary tuberculosis. Since most of the cases belonging here are of the productive and indurative scirrhotic type pneumothorax is indicated even in very advanced cases.

V. The indication for artificial pneumothorax in cases of various complications.

(*a*) Cavernous pulmonary tuberculosis. All forms of cavities whether of the generalized or of the tertiary localized stage should be treated by surgical procedures. Of course the surgical treatment should be associated with dietetic and climatic medical treatment.

(*b*) Bilateral pulmonary tuberculosis. A distinction should be made between the cases where the process in one lung follows that in the other lung and the cases where the process appears simultaneously in both lungs. It is advisable to use, in the first instance, a partial pneumothorax starting with 300 to 500 c.c. gas and increasing the amount gradually according to the tolerance of the patient. In the second group of cases pneumothorax is indicated only under very careful observation and with very small amounts of gas, applying it alternately.

(*c*) Hemoptysis. Here again distinction should be made between early and late hemoptysis. After one has successfully localized the origin of the hemoptysis pneumothorax is indicated in the early cases.

(*d*) Pregnancy. Real describes one case and Pellé 4 cases of pneumothorax successfully applied in the earlier stages of pregnancy. The symptoms were considerably relieved, the pathological process came to a standstill and the pregnancies could be carried to term.

(*e*) Tuberculosis of the larynx. Anatomicopathologically four forms of tuberculosis of the larynx are described: tuberculous infiltration, tuberculous ulceration, tuberculous tumefaction and miliary tuberculosis. More recently Aschoff, Nicol and Bacmeister have also applied to tuberculosis of the larynx the dual theory as is now accepted for pulmonary tuberculosis. Accordingly, there is exudative and productive tuberculosis of the larynx. In some cases of tuberculosis of the larynx a marked improvement was observed following pneumothorax of the affected lung.

(*f*) Tuberculous pleuritis and its sequels. In tuberculous pleuritis without adhesions pneumothorax is indicated. In cases where adhesions are localized an attempt should be made to produce a collapse of the lung and if this proves impossible, pneumolysis (Jacobaeus), phrenicotomy or thoracoplasty should be done.

VI. Contraindications. In the following conditions pneumothorax is more or less contraindicated: tuberculosis of the intestine; renal tuberculosis as well as acute and chronic glomerular nephritis and in small contracted kidneys; in all heart conditions and in advanced cases of diabetes. Sometimes in diabetes by careful insulin or synthalin therapy pneumothorax may be tried in the earlier stages of pulmonary tuberculosis. In syphilitic involvement of the lung antiluetic treatment should be carried out first.

VII. Phrenicotomy and phrenicoexeresis. In cases where pneumothorax cannot be carried out to advantage, phrenicotomy or phrenicoexeresis is indicated, although such a procedure cannot always entirely replace pneumothorax since there is only a localized compression of the lung (extending to the lower and middle lobes) and since such a procedure results in a permanent damage. Therefore before resorting to such a procedure pneumothorax should be first repeatedly attempted.

VIII. Pneumothorax and thoracoplasty. Pneumothorax is to be preferred to thoracoplasty whenever possible and only the entirely hopeless cases should be reserved for thoracoplasty. In carrying out such a radical procedure one should pay special attention to the condition of the opposite lung.

The above observations were made on a study of over 200 cases. A bibliography of 109 references is appended.—*T. Leucutia.*

Schmorl, G. Cartilaginous bodies on the intervertebral discs. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 265–279.

The anatomical structure of the normal intervertebral discs consists of three parts: the annulus fibrosus or lamellosus, the nucleus pulposus and the two cartilaginous plates. The appearance of the cartilaginous bodies is intimately connected with the changes observed on any of these anatomical structures.

If the cartilaginous bodies are the result of a direct trauma, a rupture of the cartilaginous plates of the intervertebral discs ensues and the cartilage of the nucleus pulposus continues to grow and expand towards the structure of the vertebral bodies. In this case they appear as sharply circumscribed rounded foci the size of which is from pinhead to 6 to 8 mm. in diameter.

The majority of the cartilaginous bodies, however, result from degenerative processes observed within the spinal column. These may be the result of incomplete development of the spine or of senile changes, or finally of pathological changes.

In young individuals with incomplete ossification cartilaginous bodies of the intervertebral discs may develop if for some reason a traumatic pull produces a rupture of the cartilaginous plates. The process in this instance is more or less localized and the cartilaginous bodies show a spherical shape corresponding, as a rule, to the area of the nucleus pulposus. The changes are observed principally in the dorsal and lumbar spine and only occasionally in the cervical spine.

In case of senile degeneration cartilaginous bodies may be formed due to the lessened resistance of the osteoporotic vertebrae. Of course here also the initiating motive is some injury to the cartilaginous plates. Since the process extends from the nucleus pulposus as well as from the annulus fibrosus the protrusions show a convex form with the center corresponding to the midportion of the vertebra and gradually decreasing towards the periphery.

The cartilaginous bodies observed in pathological changes may be due to tuberculosis, purulent osteomyelitis, osteoclastic cancer metastases, etc.

The author examined 3000 cases of normal spines and found that in 38 per cent there was evidence of cartilaginous bodies (39.9 per cent male and 34.3 per cent female). By taking into consideration only the age from eighteen to fifty-nine years 40 per cent of the cases involved were men and 20 per cent women. Over sixty years there were 23 per cent men and 44.3 per cent women. The author thinks that these discrepancies are due to the fact that in the period from eighteen to fifty-nine the men as a rule are the harder workers, while above sixty years women perform harder work than men.

In order to visualize the cartilaginous bodies it is necessary to take roentgenograms of the spine in the lateral view. Most of the cases examined have shown no clinical symptoms. From this the author arrives at the conclusion that the presence of cartilaginous foreign bodies is of no significance except in young individuals where it might lead to formation of spondylitis deformans or similar anomalies.—*T. Leucutia.*

Singer, J. J. Thoracic tumors; a roentgen study. *Arch. Surg.*, Jan., 1929, xviii, 283–291.

Singer describes the value of diagnostic pneumothorax and iodized oil in the diagnosis of thoracic tumors. Diagnostic pneumothorax is used to determine when the lesion is lung or pleural growth, or if fluid, some fluid is removed and air injected.

Positioning of the patient for films should be determined by the roentgenoscope, utilizing the views in which the pathology can be best demonstrated. Iodized oil, 40 per cent in diagnosis, is instilled into the lung. Its use by the bronchoscope is not recommended. The importance of biopsy is stressed. Singer states that all modern methods should be utilized for diagnosing thoracic tumors.—*E. P. Pendergrass.*

Steiert, Anton. The sella turcica in infants, its normal development and its appearance in a series of abnormal conditions. *Fortschr. a. d. Geb. d. Rontgenstrahlen*, 1928, xxxviii, 339–348.

The author gives a brief review of the literature dealing with the measurements of the sella turcica in general. The majority of authors use the diameter of the entrance as well as the depth and length of the sella in order to determine its features in different individuals. Since Haas has found that by using the above factors an error as high as 25 per cent is possible, the author advises that the surface of the sella turcica (as taken in a lateral roentgenogram with the ray of incidence over the sella) be used and calculated in square millimeters. By doing so the following observations were made from 165 craniums of normal children with regard to the development of the sella at different ages: First there is a rapid growth until the age of four, then there is a rest until the age of thirteen, and finally a second growth, probably due to the changes of puberty, until the age of sixteen. A comparsion of the surfaces of the sella in boys and girls revealed no difference except for the fact that the second growth occurs sooner in girls, sometimes beginning at the age of ten, doubtless due to the earlier onset of the puberty changes.

In a second series 150 cases of craniums were examined in children with disturbance of internal secretion, increased intracranial pressures and other abnormalities, as a rule showing changes in the shape and size of the sella. The following observations were made: Markedly enlarged sellae were found in turricephalus, hydrocephalus, cretinism, athyreosis and hypothyreosis, struma, dystrophia adiosogenitalis and congenital malacia of the cranium. Decrease in the surface of the sella was found in lipodystrophia, dystrophia musculorum progressiva and general dwarfism. In adiposity the result was not conclusive. In the Herter type of infantilism a slight increase in the average value was noticed. In genuine epilepsy a thickening of the anterior clinoid processes or of the dorsum sellae or both was observed. The sellae of idiots showed nothing of interest with regard to size and shape.—*T. Leucutia.*

Stoloff, E. Gordon. Spontaneous nontuberculous pneumothorax in infancy and childhood. *Am. J. M. Sc.*, Nov., 1928, clxxvi, 657–664.

Stoloff in a review of the literature from 1844 to the present date allows a tabulation of 84 cases of spontaneous pneumothorax of nontuberculous etiology. The etiology and pathogenesis of spontaneous pneumothorax with particular reference to the accompanying compilation was considered. Tuberculous disease is probably the most frequent single cause. Pneumonia follows with a 35.7 per cent incidence in this tabulation; then emphysema and gangrene. Expressed pathogenetically, pneumothorax may be caused by (*a*) degeneration in the lung (abscess, gangrene, bronchiectasis, infarction, empyema, or (*b*) rupture of the lung due to congenital defect, emphysema, foreign body.

The roentgen diagnosis is discussed. Pneumothorax, either open, closed, or of the check-valve variety, may be seen as partial or total, unilocular or multilocular, simple or complicated, and unilateral or bilateral.

Three cases of nontuberculous spontaneous pneumothorax are added to the literature: all were postpneumonic, simple (uncomplicated), and made uneventful recoveries. Their recognition was made on the basis of roentgenography; they were characterized by a sparsity of clinical manifestations and signs which probably would not have sufficed to enable the diagnosis in the absence of the roentgenograms and roentgenoscopy.

—*E. P. Pendergrass.*

Stöffel, Hans. Roentgenography of the anterior portion of the eyeball without the demonstration of bone structures. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 96–100.

A description of Vogt and Haemmerli's method for roentgenography of the anterior portion of the eyeball without including the bone structures is given. This is as follows: A duplitized roentgen film is cut 2 cm. wide and 6 cm. long, one end of the film being rounded. The film is placed on a lead sheet 1 mm. thick and it is then placed with the rounded end towards the orbit against the

anterior portion of the eyeball. Two positions are especially recommended: (1) the film is placed with the rounded end (after anesthesia of the eyeball with 3 per cent cocaine solution) at the inner canthus of the eye in the conjunctival sac so that the incidence of the radiation is directly temporonasal, or (2) the film is placed with the rounded end underneath the lower eyelid (and not in the conjunctival sac) and the roentgenogram is taken from above with an incidence of 60°.

In using the above two positions exposures are taken, moving the eye in different directions such as inwards-downwards, inwards-upwards, outwards-downwards, outwards-upwards and straight forwards.

The method is especially advocated in cases of foreign bodies of the anterior portion of the eyeball as well as of the upper eyelid. For this latter a special technique is advised; in as much as the film is placed underneath the upper eyelid. The advantages of the procedure are that because of the relatively soft exposure non-metallic foreign bodies can also be demonstrated and furthermore it gives a very good localization of all foreign bodies located in the anterior portion of the eyeball. Its disadvantages are that the film has to be held by hand during the exposure so that the operator is exposed to the danger of roentgen dermatitis, and that it cannot be applied to foreign bodies which lie behind the center of the eye.

—*T. Leucutia.*

Stumpf, Pleikart. Form changes of the beating heart in roentgenography. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 1055–1067.

The roentgenologic registration of the heart action is an old problem. Following Rieder's procedure for the demonstration of the peristalsis of the gastrointestinal tract, Groedel tried in a like manner to record the heart movements by means of cinematography. Such a procedure, aside from the technical inefficiency, has also the disadvantage that it registers the different phases of heart action only in one direction. Simultaneous roentgen cinematography in several directions would be necessary in order to accurately evaluate all facts pertaining to heart pulsation.

A second and somewhat better method is roentgen kymography. Here the contour of the heart is registered by a series of linear roentgenograms taken consecutively through one or more narrow slits on a motor driven film. Several authors have suggested that the marginal movements observed in the kymograms so taken be analyzed by means of an electrocardiogram.

A third method is densography. It is a well-known fact that the density of the shadow in a roentgenogram expresses the absorption capacity of the irradiated tissue or organ. In an actively contracting organ such as the heart, the changes in density are synchronous with the contraction. Thus while kymography registers only the contour of the pulsating heart, densography gives information also with regard to the volumetric changes during contraction. From the rhythmic variation of the density conclusions may be drawn with regard to the rate of the heart action. Furthermore, by a combination of kymography and densography both the space and time factors regulating the function of the heart may be evaluated.

Isography means the graphic connection of points of equal density. The lines or graphs so registered express the modifications in the configuration of the heart produced during the contraction.

The author gives a very detailed description of the different methods used in kymography, densography and isography. While there has been a great improvement in the technique during the last few years the final word has not been said as yet. This applies especially to the registration of the space factor in densography.

From numerous observations of his own the author arrives at the conclusion that although the above procedures have not as yet reached the stage of practical application they have at least brought to light one new fact, namely, the importance of the movements of the septum during the contraction of the heart. There can be no doubt that the alternating densographic changes observed regularly within the image of the heart shadow are due to the rhythmic movement of the septum. The importance of this movement has not as yet been sufficiently studied.—*T. Leucutia.*

Winckler. Does cranial stenosis always result in narrowing of the fluid spaces and in diminution in the amount of cerebrospinal fluid? *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 101–103.

Denk recently made the following statement: "In cranial stenosis there is a pronounced diminution in the amount of the cerebrospinal fluid and a narrowing of the fluid spaces which can be easily demonstrated by encephalography." Winckler doubts the truth of the above statement and he cites a case of an epileptic fifteen years of age who presented signs of cranial stenosis but without diminution in the amount of cerebrospinal fluid and without decrease in the size of the fluid spaces.

It was easily possible to withdraw 100 c.c. of cerebrospinal fluid without causing any subjective symptoms.

The roentgenograms revealed a total disappearance of the cranial sutures indicating that the cranial stenosis was the result of premature ossification of the cranial sutures.

The author also discusses the relationship of cranial stenosis to oxycephalus. In this latter the lamboid suture is still visible. The case of an imbecile twenty-nine years of age with oxycephalus is described, the roentgenogram of whose skull showed all the signs of cranial stenosis but with visualization of the lamboid suture.—*T. Leucutia.*

ZEHBE, MAX. Attempt to prove that the roentgenogram of the normal and the pathological human stomach is the expression of the architecture and tonicity of the musculature. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 38–48.

The author analyzes the various changes shown in the roentgenogram with regard to the Forssell theory of the muscular architecture of the human stomach. From numerous observations on the normal and pathological stomach, he arrives at the conclusion that Forssell's theory has an application also for the pathological stomach. The studies were carried out mostly in cases of gastric ulcer. All changes in the shape of the stomach, whether or not produced by an increased or decreased tonus of the musculature such as described by Forssell could be observed in corresponding pathological conditions. The observations were verified by means of numerous roentgenograms.

—*T. Leucutia.*

ROENTGEN AND RADIUM THERAPY

HALBERSTAEDTER, L. Technique of intratumoral treatment with thorium x. *Strahlentherapie*, 1928, xxix, 707–710.

Four years ago the author reported that it is possible to use thorium x for intratumoral treatment in the same way that radon is used in America. He describes and illustrates six different forms of thorium x rods. They have used these rods in many hundreds of cases in the Berlin Cancer Institute and believe they can be used in all cases in which radon can be used but as they are solid they can be used much more advantageously than the gaseous radon. With these six forms of rods great adaptability is possible. The choice in the individual case is based on experience and with increasing practice the possibilities for their use are increased.

KREBS, CARL. Experimental studies concerning the radiologic treatment of cancer uteri. *Acta radiol.*, 1928, ix, 1–8.

From a short review of the literature, the author finds that the lethal dose for carcinoma and sarcoma generally corresponds to 4 to 6 human skin erythema doses; for unfiltered radium the lethal dose is 100 mg. for ten minutes.

The author undertakes some experiments in order to determine the lethal dose for both carcinoma and sarcoma by placing fragments of different animal carcinomas and sarcomas in the uterus, cervix and vagina of human females secured at autopsy. The mouse carcinoma used for the experimentation was an adenocarcinoma, relatively benign, with a take of 60 to 80 per cent, which had been cultivated for more than 30 generations. When transplanted to the thoracic wall, it produced death in sixty to eighty days, in about 5 per cent there having been evidence of metastases. The mouse sarcoma used for the experimentation was a giant cell sarcoma, very malignant, with a take of 96 per cent, which had been cultivated for 60 generations. When transplanted subcutaneously to the thorax it killed in thirty days, lung metastases having developed in about 10 per cent. The lethal dose for both of these experimental tumors was determined as being six erythema doses, through 2 mm. Al, regardless of whether or not the determination was done in vivo or in vitro. The following four ways were used to determine the effect of the irradiation: (1) the percentage of takes; (2) the life duration after the graft; (3) the time limit of the take (time of latent incubation), and (4) the rate of growth of the tumor.

The experiments were carried out both by using radium alone and radium in combination with roentgen rays. The following was the method of procedure: At autopsy the uterus and the upper three-fourths of the vagina were removed. Fresh aseptically removed carcinoma and sarcoma tissue was cut into four pieces, each as large as a kernel of a hazelnut, and placed in sterilized rubber caps in a sterile physiological saline solution. The cervix of the removed uterus was slightly dilated and two of the rubber caps, one containing carcinoma tissue and the other containing sarcoma tissue were placed high into the uterine cavity; two others were placed at the junction of the cervix and the body of the uterus, and finally two others in the vagina at a distance of

6 cm. from the cervix. The remaining two caps—one of each—were used as controls.

The technique of the irradiation used in the experiments was as follows: a tube of 70 mg. of radium element screened by 1 mm. silver and 1 mm. brass was placed within the uterine cavity. A plaque of 60 mg. radium element screened by 1.7 mm. lead and 0.5 mm. silver was placed against the portio vaginalis. The radium was left in situ for a period of thirty-six hours and the specimens, together with the control specimen, were placed at a temperature of 8°C.

In the experiments in which roentgen rays were used in addition to radium, a piece of skin with subcutaneous fat about 3 cm. thick was placed over the uterus, making a distance from the surface of the skin to the center of the uterus about 7 cm. The dose administered was one skin erythema dose through 0.5 mm. Zn and 1 mm. Al filters, at a distance of 40 cm. The radiation was given immediately following the thirty-six hour radium application.

The tumor tissues were then removed and grafted, under ether narcosis, on mice; two pieces of the same kind of tumor to each animal, one in each axilla.

The following are the results of the experimentation: The tumor tissues placed within the uterine cavity, as well as the tumor tissues placed at the junction of the cervix and body of the uterus, were entirely killed by the radiation, none of the grafts having taken. The tumor tissues placed in the vagina showed only slight inhibitory effect, the majority of the grafts having taken.—*T. Leucutia.*

Nemenow, M., and Jugenburg, Anna. The radiation therapy of tumors of the hypophysis. *Strablentherapie*, 1928, xxx, 239–276.

The authors have had nine years' experience in the use of roentgen rays in the diagnosis and treatment of tumors of the hypophysis. Since 1919 they have seen 45 cases with pronounced roentgen symptoms of pathological enlargement of the sella turcica. In this article they consider only 29 of these cases which showed endocrine symptoms; 18 of these were cases of acromegaly and 11 of them dystrophia adiposogenitalis. Of the 18 acromegaly cases, 13 were in women and only 5 in men. A number of typical cases are described and illustrated with photographs and roentgenograms.

The irradiations were given over 4 or 5 fields measuring 6 × 8 cm. The distance from the anticathode was 23 cm.; a tension of 200–220 kv. was used and a filter of 0.5 mm. zinc and 3 mm. aluminum; ⅘ of an erythema dose was given on each field, which caused the hair to fall out but did not cause any inflammation. In stubborn cases and where rapid action was desired, the roentgen irradiation was combined with radium irradiation from the roof of the pharynx. Generally the radium irradiation was given two to three weeks after the roentgen irradiation. The second series of roentgen irradiations was not given for three months after the hair had grown again.

Tumors of the hypophysis cause two kinds of pictures and both the acromegaly and the dystrophia adiposogenitalis are polyglandular syndromes. Radiation therapy is the treatment of choice in these cases. The results are often improved by irradiation of other glands as well as the hypophysis. In one case with the clinical picture of persistent thymus, irradiation of the thymic region brought about rapid improvement in the blood picture and general condition. In some cases by irradiation of the ovaries as well as the hypophysis the menses, which had stopped for years, were re-established. Roentgen therapy gave permanent results.

Roentgen examination of the sella turcica shows the localization of a process in the hypophysis and explains the visual disturbances. If there are marked clinical signs of acromegaly and normal sella turcica the hypophysis probably lies in the roof of the pharynx and in that case radium treatment is indicated. In dystrophia adiposogenitalis with a normal sella the cause of the disease probably lies in the midbrain; roentgen therapy should generally not be used in these cases. In one case there was recurrence. In two other cases autopsy showed tumor of the hypophysis though there had been almost no symptoms. The roentgen treatment must be continued for years, of course with long intervals, and the sella examined roentgenologically from time to time. Progressive destruction of the sella indicates tumor even if the symptoms are not progressing, and the treatment should be continued.

The authors' cases show that diabetes insipidus is not caused by destruction of certain parts of the hypophysis but rather by irritation of certain centers as a result of pressure by the tumor or pressure on the infundibulum; it is impossible to explain the cure of diabetes insipidus by irradiation otherwise. That the diabetes insipidus is caused by irritation of certain centers is shown by one of the authors' cases in which the diabetes disappeared with increase in size of the metastatic tumor of the hypophysis.

Odqvist, Henning. A case of multiple dermal cancer in the face and on the neck. *Acta radiol.*, 1928, ix, 302–304.

The author describes a case of multiple dermal cancer of the face and neck in a patient aged seventy-three. The histological examination indicated the presence of two different types of lesions—basal cell carcinoma and scirrhous carcinoma. The lesions were treated by the combined method of roentgen therapy and electrocoagulation, with excellent results. —*T. Leucutia.*

SCHMITT, WALTHER. Injury of the offspring by irradiation of the ovaries. *Strahlentherapie*, 1928, xxx, 24–64.

Forty-two pregnancies are reported in 25 women who had been given roentgen treatment of the ovaries. In 3 of the cases there was conception within three months after irradiation had been given to bring about permanent cessation of menstruation. In 2 of the cases the conception followed sterility of seven and ten years' duration. One of the children is well developed and healthy, one is somewhat undeveloped physically and one has a metabolic disturbance. There were 16 pregnancies in 11 women in whom there was a considerable period between irradiation for permanent amenorrhea and conception; 3 of them ended in abortion. Twelve of the 13 living children born in this group were very well developed and showed no abnormalities. One child was born prematurely and died when five days old. No defects of development were found on autopsy. Two children died of tuberculosis at the age of one and two years. Six of the 10 surviving children were examined when from one to five years of age; they showed no gross disturbances of development. One child showed a stereotyped rocking movement of the head when sitting.

Seventeen pregnancies were seen in 8 women after the use of small doses of roentgen rays to regulate menstruation. The interval between the irradiation and the first conception was from ten months to four years and ten months. Twelve of these pregnancies ended in the delivery of living children, 4 of whom were reported weak at birth but none of whom showed any anomalies. One child later showed a heart lesion, probably congenital. One died of intestinal catarrh when three months old. Ten of these children were examined at the age of one and a half to six and three-fourths years. All except the child with heart disease were physically and mentally normal.

Four pregnancies occurred in 3 women who were irradiated for the purpose of producing temporary amenorrhea; all of the pregnancies resulted in living children, fully developed and without any abnormalities. One woman was given stimulant irradiation of the ovaries. Two pregnancies followed, the first one four months and the second one one year and five months after the treatment. The first child appeared to be well at birth but died of convulsions thirteen days after birth. The second one was premature but is developing well.

The number of cases is small but they present no definite evidence of injury of the offspring by the irradiation.

SCHOENHOF, S. Roentgen treatment of skin tuberculosis. *Strahlentherapie*, 1928, xxx, 375–384.

Recently several authors have reported that roentgen treatment of skin tuberculosis is not only useless but dangerous, and that the only suitable treatment is Finsen or ultraviolet light. The author admits the value of the light treatment but it is very expensive and requires an enormous amount of time and he holds that roentgen treatment has its indications in this field. Tuberculosis of the skin can rarely be completely cured by roentgen treatment but in combination with other methods the results can be improved and the time required for treatment shortened. He has had his best results in the treatment of the exudative forms of lupus. In hypertrophic and ulcerated forms of lupus the extensive infiltration can be overcome and the ulcers healed over quickly. In either case the tuberculous tissue cicatrizes, but slight infiltrations often remain in the scars which are refractory to roentgen treatment and these must be treated with light, cauterization or silver nitrate. Roentgen treatment of lupus nodularis planus is rarely effective; it must be transformed into an ulcerated form by the use of caustics. The author in recent years has used a 25 per cent quinine salve almost entirely, sometimes after a short preliminary treatment with potassium hydroxide or pyrogallol vaseline. This does not cause such deep necrosis as some of the other caustics but injures normal tissue less and is not very painful. At the height of the caustic action ⅓ to ½ an erythema dose of moderately filtered rays is given and the wounds healed with soothing salves. Two weeks later a second irradiation with the same dosage may be given. This treatment has the advantage over pure caustic treatment that the wounds heal quicker and less tuberculous tissue remains; this can be removed by a second caustic and roentgen treatment, which however must not be given before six or eight weeks. The scars are soft and the cosmetic results good.

Roentgen treatment can also be used with advantage after the excision of isolated foci to bring about smooth scars free of keloid and

the author believes recurrence is less frequent after this than after other methods. He tries not to give more than two erythema doses but sometimes gives three. He never goes beyond that and thinks that is the reason he has never had any serious roentgen injury. He has found a 3 mm. aluminum filter sufficient to protect the skin and give a satisfactory deep dosage. He thinks the roentgen injuries reported have been due to the use of too frequent irradiation and too short intervals. He thinks carcinoma is not any more frequent in cases of lupus treated by irradiation than in others. Roentgen treatment is even more effective in lupus of mucous membranes than in that of the skin. In either case it should be supplemented by general irradiation with ultraviolet light, the parts of the skin that have been given roentgen irradiation being carefully covered.

The best field for the use of roentgen rays is in colliquative tuberculosis, particularly scrofuloderma. Under local roentgen treatment the secretion at first increases and then the infiltration recedes and the fistulae close. One-third to one-fourth of an erythema dose should be given at intervals of one to two weeks with an interval of six to eight weeks after the whole of an erythema dose has been given. Ultraviolet treatment may be given during this interval.

v. Büben, I. The results of roentgen treatment of pruritus vulvae. *Strahlentherapie*, 1928, xxx, 385–390.

Roentgen treatment was first used for pruritus vulvae in 1907 and from the favorable reports made at that time it was thought that the question of treatment in this condition was definitely settled. But later reports were less and less favorable until some authors said that roentgen treatment of pruritus vulvae was absolutely useless. The author has been using it since 1910 and has treated 83 cases; 32 of them were symptomatic and 49 essential. Nine of the patients did not come back after the first treatment leaving 72 that have been under observation for some years. At first soft rays were used but the results have been better with the hard radiation used later. Recently a radiotransverter apparatus has been used with a charge of 146 kv. and 8 ma. with a focus distance of 30 cm. and a filtration of 0.5 mm. zinc and 0.5 mm. aluminum; treatment 7–8 minutes. This gives 70–85 per cent of a skin erythema dose. The treatment was repeated after six weeks if necessary. Some of the patients were cured after one or two treatments, some of them required longer. Among the 72 cases, 43 were cured, or 59.7 per cent. So though the first hopes entertained for the treatment have not been fulfilled more than half the cases are cured, which is better than the result of other forms of treatment.

v. Spindler, H. Roentgen irradiation of joint tuberculosis through the plaster cast. *Strahlentherapie*, 1928, xxix, 806–809.

Some time ago roentgen irradiation of joint tuberculosis through the plaster cast was recommended. The author does not think it is a method that should be used. In the first place there is some danger in irradiating any part of the body without being able to keep it under observation. There is no fixed dose for joint tuberculosis and dosage should be regulated according to the effects, which cannot be followed under the plaster cast. In addition to that, accurate dosage is almost impossible on on account of the secondary radiation produced by the cast itself. The surface dose to a depth of about 10 cm. is larger than the dose given on account of this secondary radiation; the skin therefore receives a larger dose than is calculated and the deeper diseased tissue a comparatively smaller one. And it is impossible to calculate the value of this secondary radiation accurately because the cast is modelled to the body and is thicker in some places than in others.

Wagner, Aage. A case of sarcoma developing after radium treatment of epithelioma in the temporal region. *Acta radiol.*, 1928, ix, 370–382.

The author describes a case of an epithelioma of the left temporal region which was treated by repeated radium applications. The lesion later transformed into a sarcoma. The following possibilities are discussed with regard to this transformation: (1) the original tumor might have been a carcinosarcoma, the radium application having thus destroyed the carcinoma component of the tumor; (2) the connective tissue might have undergone sarcomatous changes due to the irritative action of the living or disintegrating carcinoma cells; (3) the radium rays might have given rise to sarcomatous proliferation, and (4) a direct metaplasia of the epithelial cells might have occurred.

Various authors are cited in support of the above theories. Wagner himself arrives at the conclusion that a direct metaplasia of the carcinoma cells is the most probable explanation.—*T. Leucutia.*

Werner, R. Indications for roentgen treatment of malignant tumors. *Strahlentherapie*, 1928, xxx, 1–23.

If there is no immediate danger in brain tumor roentgen treatment may be tried, combined where advisable with decompressive trephine. Many brain tumors treated in this way have improved greatly and remained free of symptoms for years. The same is true of tumors of the pituitary body. Metastatic carcinomas and sarcomas of the spine have disappeared under roentgen treatment. Some cases of glioma of the eyeball have responded well but great care must be used in the treatment in these cases. Tumors of the nasopharynx often recede very rapidly under roentgen treatment. But tumors of the upper jaw are generally refractory to irradiation. It is much more effective in sarcoma of the tonsils than in carcinoma. In malignant tumors of the hypopharynx up to the entrance of the larynx the prospects for surgical treatment are poor. In these tumors concentric multiple-field irradiation with radium or roentgen rays from outside is the method of choice. In carcinoma of the mucous membrane of the mouth radium, either internally or by combined internal and external application, is the only method that has given relatively good results. The author recommends trying external radium treatment before operation in sarcoma of the sternum or ribs. In carcinoma of the esophagus roentgen treatment should be given only in small doses and at long intervals. The immediate results of roentgen treatment of tumors of the mediastinum are good, the ultimate results uncertain. Radium is to be preferred in malignant tumors of the thyroid. The roentgen dosage in sarcoma of the lungs and bronchi must be small; it may bring about improvement of long duration. Intense irradiation in these cases may cause fatal hemorrhage. Metastatic tumors of the gall-bladder and liver react better to roentgen rays than primary tumors at this site. In inoperable tumors of the gastro-intestinal tract improvement may sometimes be brought about by small daily doses of roentgen rays. The author saw one case of recurrence of a carcinoma of Vater's papilla cured permanently by roentgen treatment. The only intestinal carcinoma in which roentgen treatment has been very successful is that of the sigmoid flexure. In carcinoma of the rectum preoperative roentgen treatment improves the conditions for operation. Malignant tumors of the prostate, particularly sarcomas, respond well to roentgen treatment alone and still better to roentgen irradiation combined with radium needles. Roentgen treatment has sometimes given good results in carcinoma of the bladder. Irradiation has given good results in some cases of sarcoma and carcinoma of the ovary. In carcinoma of the portio preoperative treatment with radium is to be preferred; postoperative treatment with roentgen rays.

MISCELLANEOUS

Behnken, H., and Jaeger, R. The gauging of roentgen dosimeters with radium. *Strahlentherapie*, 1928, xxx, 193–194.

This is a brief note on the authors' work published in volume 29. Their attention was called to the fact that the conclusion was drawn from their work that they believed that bakelite was not a suitable material for making ionization chambers but that the material they used in those experiments was to be preferred. They did not mean this to be a general statement but to apply only to the conditions of that set of experiments. They think it quite possible to make good ionization chambers with bakelite, if it is properly lined, which are independent of the quality of the rays. If the greatest independence of quality is to be attained as light and thin a material as possible should be used and bakelite meets these requirements.

Behnken, H., and Jaeger, R. The gauging of roentgen measurements of dosage with radium. *Strahlentherapie*, 1928, xxix, 483–502.

Solomon's unit of dosage in the form in which it has been used so far is not reliable, as it is dependent on the material, form and size of the ionization chamber and details of the mutual position of the chamber and the radium preparation. In order to make it reliable all these things must be accurately defined. But this would be putting insuperable difficulties in the way of further development of the technique of dosimetry. For at present all the ionization chambers in use, even those independent of the quality of the rays, are very defective, and they are particularly not adapted for measurements on the phantom. This is why there are not up to the present time any generally recognized tables for the distribution of the dose in the deep tissues. So it is still too early to say that any special kind of small chamber can be taken as the standard. For this reason the Solomon unit cannot be used as an international unit. It is a practical unit at most for those institutions that are adjusted to the Solomon measuring apparatus and which do not use any other apparatus.

This does not mean that it is necessary to reject radium preparations in the control of measurement of roentgen dosage. On the contrary, such control is not only very useful, but even unconditionally necessary. For in all

practical measurements of dosage there is great danger of a change in sensitiveness. This danger can be met only by suitable controls. But if small chambers are to be controlled with gamma rays the authors think that preparations larger than 10 mg. are necessary. Large chambers, like Küstner's gauging apparatus, can get along with considerably smaller preparations, but gamma rays need not necessarily be used. A sufficient control can generally be attained by the use of uranium oxid, as has often been described by the authors, and which has long been in practical use in the Siemens dosimeter. This utilizes alpha and beta irradiation so that only small amounts of uranium, worth only a small sum, are necessary.

The authors' experiments also show that a reliable gauging of small chambers with gamma rays is possible indirectly but that the method is very complicated. It can hardly be used by the practitioner. If the unit of dosage is to be used practically it is preferable to stick to the absolute measurement of true air ionization in a definite amount of air, for this is the only method of measurement that is sufficiently developed technically. It is accurate enough for practical purposes and can be developed further without its being necessary to change the definition of the unit. If the technique of measurement should ever make it possible to change to an energy measurement for dosage, which does not seem very probable at present, the transition from the reliable ionization unit to the energy unit will not be difficult.

Carlsten, Dag B. Some practical experiences with the Baastrup-Johnson dosimeter. *Acta radiol.*, 1928, ix, 98–105.

The author describes, on the basis of his own experiments, the advantages and disadvantages of the Baastrup-Johnson dosimeter, an instrument which measures the dose given by variations of resistance. The procedure of measuring is described as follows: The chamber of the dosimeter, which has the form of a flat box about as large as an ordinary watch, is placed in the center of the irradiation field on the surface of the patient's body. The box is constructed of thin aluminum and is connected with the instrument board by means of a rigid aluminum tube which is barely as thick as the little finger and is about 50 cm. long. On the instrument board of the apparatus the operator has before him two voltmeters each with its hand wheel for regulating the resistance. First he sets the pointer of one of the voltmeters to a so-called zero position; then by means of the other hand wheel he turns on so much current from a battery on the instrument board that the pointer of the first voltmeter is not deflected from its zero position by the current from the dosimeter box. This requires a current directly proportional to the intensity of the roentgen light and the degree of that intensity can thus at any moment be read on the voltmeter. The current coupled in by means of the second hand wheel passes through an ordinary electrometer which, with its figures from 1 to 10, plainly registers the dose or fractions of it. A third hand wheel on the instrument board serves for setting the apparatus beforehand to the dose required. This latter is graduated in R's and thus gives the dose in absolute units.

The disadvantages of the apparatus are that the dosimeter has to be closely observed and manipulated during the entire length of the treatment. The voltage scale is not sufficient for the measurement of higher quantities of radiation. In case of non-filtered or only weakly filtered radiation the box itself acts as a filter and thus measurements are not correct. Carlsten thinks that after making some practical changes in order to correct the above errors the instrument will be of a real value. It represents the first self-integrating dosimeter.—*T. Leucutia.*

Casati, A. The reducing power of roentgen rays. *Radiol. med.*, Dec., 1928, xv, 1215–1224.

The author under special experimental conditions saw a reducing action take place in an irradiated solution of copper sulphate which was apparently due to the action of roentgen rays and so tried to determine whether this reduction occurred by chance or whether it was an elementary chemical reaction caused by the rays. For this purpose he irradiated a 1 per cent solution of sublimate, taking care to eliminate all physical or chemical factors which might have brought about or facilitated such a reaction. A fine yellowish precipitate formed in the solution. Chemical examination of this precipitate showed that it was calomel. Encouraged by this first result he is continuing his experiments.

Cohn, A., and Levy-Dorn, M. The effect of roentgen rays on pure cultures of gonococci. *Strahlentherapie*, 1928, xxvii, 746–750.

Articles have been published on the effect of roentgen rays on the clinical symptoms of gonorrhea, but little work has been done on the direct effect of the rays on the gonococci themselves. The authors made experiments on 7 strains of gonococci cultivated on Levinthal's blood agar. They were irradiated and transplanted to other blood-agar plates twenty-four

to forty-eight hours later and observed to see whether they would grow after the irradiation. In 12 cases they were irradiated under a copper filter 0.6 mm. in thickness, doses up to 3 H.E.D. being given. In the other 13 cases the filter was not used. The irradiation in these cases was about 37 H.E.D. The tension was 180 kv., the focus-plate distance in most cases 20 cm. A table is given showing the details of the results. The experiments show that in spite of their fragility in other ways gonococci, like many other microorganisms, are not very sensitive to roentgen rays. Only one of the strains did not grow after the irradiation.

CRAMER, H. Biological action of roentgen rays. *Strablentberapie*, 1928, xxviii, 431–481.

Experiments on the biological action of the rays show that in death of experimental animals from rays there is an elective destruction of the organs of the reticulo-endothelial system. The lymphocyte curve shows the functional condition of the mesenchyme: activation by small doses, reparable destruction by moderate doses, irreparable injury by large doses. Acute injury in roentgen sickness is soon compensated if roentgen cachexia is not produced. There is a detailed discussion of the reticulo-endothelial system, extending the conception to include the whole mesenchyme. There is an elective adsorption of activated products of metabolism circulating in the blood at the place of increased metabolism, and this explains a large part of the action of the rays both on processes of inflammation and on tumors. These processes explain the mode of action of protein bodies and their equivalents —colloidal metals, colloidal stains, light and, insofar as they act indirectly, roentgen and radium rays. The organs that adsorb vital stains are the ones that are acted on indirectly by roentgen rays: primordial follicles are not stained, mature follicles stain well. The possibility of nonspecific immunization and nonspecific increase of bacteriolysis by activation of complement is also discussed and the conclusions applied to the action of roentgen rays.

Attention is called to the great physiological and pathological importance of certain products of catabolism which are called proteinogenous amins and their development in the indirect action of rays probably explains many of the phenomena observed. For instance there is certainly a histamin action involved in the dilatation of the capillaries in erythema and this or a related principle seems to be the cause of most of the humeral and nervous phenomena. It has recently been found that at the height of the action of the rays when they are applied locally there is a dilatation of all the peripheral capillaries. This and the fact that there is dilatation of the capillaries on a meat diet suggests that the action on the vessels is caused by histamin. There is a striking similarity in the action of histamin and ray intoxication: both cause vagotonia, lymphagogia, acidosis and migration of leucocytes.

It is shown that autolysis is sufficient for the destruction of cells only if there are very severe disturbances of cell structure and that the reason it is so difficult to destroy cells in vitro is that the active mesenchyme is lacking. An intact cell structure places limits on any nonspecific treatment of tumors.

After discussing the reticulo-endothelial system as a digestive gland and the important metabolic waste products that develop in the process of digestion their elimination is taken up. They are partly excreted through the skin and mucous membrane. This explains the varying sensitiveness to rays of the different structures of the skin; the hair papillae and glands on account of their more active metabolism adsorb more than the epithelium and are therefore more sensitive to rays. Roentgen carcinoma and carcinoma from irritation are also explained by this action of the skin as an excretory organ.

Pigment is a product of intracellular oxidation. A method of intravital demonstration of dopa-oxydase under the influence of the action of the rays is demonstrated. The first phase is an inhibition of ferment while the phase of erythema represents an activation of ferment. No therapeutic conclusions will be drawn until further work has been done. The experiments show that therapeutic stimulant roentgen irradiation is an indirect stimulus and equivalent to a protein body therapy.

FORSSELL, GÖSTA. The radiotherapeutic clinic of the Cancer Association in Stockholm, "Radiumhemmet," its organization, working methods and therapeutic results. *Acta radiol.*, 1928, ix, 315–369.

The Radiumhemmet was founded in 1910 by John Berg. First it functioned as a private undertaking; in 1911 it was given over to the Cancer Association. Since 1913 the institution has been supported jointly by the Cancer Association, government, city and the University of Stockholm.

1. *Organization.*

(1) Radiotherapeutic clinic. It has 34 beds. The number of admissions in 1927 was 1,083.

(2) Radiotherapeutic polyclinic. This functions in connection with the radiotherapeutic clinic. The number of admissions in 1927 was 5,085 and the number of examinations 16,815.

(3) Radium division. This forms a part of the polyclinic. The total amount of radium owned by the division is about 2.5 gm. Of this 2,026.31 mg. radium is in the form of radium salt (radium sulphate) divided in 113 gold platinum tubes and needles and 35 plaques for superficial therapy; 500 mg. radium element is used in ten special containers for distant radium therapy. In 1927, 2,606 radium treatments were given. The protection against the radium is thorough. The nurse in charge is on continuous duty only every other month. For the construction of radium applicators pupil nurses are used who stay in the department only for a period of two months.

(4) Roentgen division. There are two treatment divisions with five treatment units. The protection here also is complete. The tube boxes are lined with lead rubber 8 mm. thick while the walls of the room are lined with lead 5 mm. thick. Thus the operator is protected against both the direct and indirect radiation. The working hours are eight hours per day with Sunday and one afternoon off and with two months' vacation, one month during the winter and one month during the summer. The total number of roentgen treatments during 1927 was 10,771.

(5) Operating room. The operating room is used for treatments with the combined method of surgery and radiation, as well as for electrocoagulation. In 1927, 110 electrocoagulations, 347 desiccations and 13 small operations were performed.

(6) Division of charting and follow-up system. Charting is done according to the Mayo Clinic and the Memorial Hospital of New York. The follow-up system is very thorough so that records are available at any time about the actual condition of the patients. For example, the 1,481 cases of cancer of the cervix treated during 1914 to 1927 were all followed up within 100 per cent. The following data, which are also used for the classification of the final results, are noted in the follow-up charts: 1. Symptom-free 2. Symptom-free, death from intercurrent disease. 3. Symptom-free, recurrence, again symptom-free, improved. 4. Symptom-free, recurrence, deterioration. 5. Improved. 6. Temporarily improved, then deterioration and death. 7. No effect. 8. Still under treatment. 9. Treatment interrupted. 10. Treatment not indicated. For carcinoma of the breast and uterus special files are kept.

(7) Physical laboratory. The duties of the physical laboratory are the control of the apparatus, the supervising of the protection arrangements, the measurement of doses and scientific research on subjects of medical radiology. The personnel consists of a physicist, a scientific assistant (engineer), and a technical assistant. The laboratory also functions as a standardization bureau for all roentgen dosimeters of Sweden.

(8) Anatomico-pathological division. Since 1916 a histological division and since 1925 an experimental division has been founded as an adjunct to the pathological division. Mostly tumor pathology and tumor biology are studied.

II. *Working Methods and Working Problems.*

The institution as a whole has two main purposes. First, the study of the effect of radiation in tumors by means of systematic treatment methods in humans; second, a study of the radiation effect on the normal organism and on tumors by means of animal experiments.

Another purpose of the institution is to organize postgraduate medico-radiological instruction. The instruction in medical radiology in Sweden dates back to 1908 when for the first time a private course was created at the Seraphim Hospital. In 1914 a regular voluntary course was given at the Caroline Institute in Stockholm. Since 1916 a similar course has been given in Lund and since 1919 in Upsala. Since 1924 the course in roentgenology has been obligatory for all students. Since 1927 there have been three courses for medical radiology, one at the Caroline Institute in Stockholm, one at the University of Lund and one at the University of Upsala. At the present time the obligatory instruction in roentgen diagnosis comprehends a course of twenty hours; in addition to this there are voluntary courses of forty-eight hours and several practical courses. The postgraduate teaching for physicians who wish to specialize in roentgenology is done in the following way: A student receiving his medical degree spends two to three years on the medical or surgical division of some recognized hospital, then six months to one year as assistant in the diagnostic division of the Seraphim Hospital, then two years as assistant at Radiumhemmet, and at least one more year at the roentgen institute in Seraphim Hospital. After completing this instruction he is appointed as chief of a roentgenological division of some hospital in Sweden.

III. *Treatment Results.*

A. General principles of radiation therapy. The method of treatment and the technique of exposure are of prime importance in the results obtained by radiation therapy. A treatment once started has to be systematically carried to the end.

The dose applied at Radiumhemmet is the massive dose and it is given during the shortest possible time, usually in one sitting, or in more advanced cases where this is impossible, in two to three sittings. There is no such thing as a uniform carcinoma dose but we can talk about the minimum carcinoma dose which is necessary to produce a therapeutic effect and about a maximum dose which still can be tolerated by the normal tissues. It is a matter of common knowledge that the irradiation has also to take into consideration normal healing processes. A treatment which is extended over a longer period is more apt to destroy the mechanism of the normal healing process (by producing radiation changes of the tissues such as fibrosis, sclerosis, leather skin, tendency to necrosis, etc.). Therefore the treatment should be completed if possible before these secondary changes have occurred. In the combination of radium and deep roentgen-ray therapy preference is given to radium in the treatment of the majority of malignant conditions. Thus, in skin, lip, cervix and mouth cancers, radium is always used for the treatment of the primary lesion; in some instances, especially in mouth cancer, in combination with electrocoagulation. Roentgen therapy is reserved for the treatment of the adjacent lymph nodes, alone, or in combination with surgical procedures. In the pre- and postoperative treatment of other cancers roentgen therapy or, in some instances, radium therapy is applied. In sarcoma, a combination of the two methods is used.

B. Results. In the first eleven years, from 1910 to 1920, 7,500 cases were treated at Radiumhemmet; during the following five years 11,000 cases, making a total of 18,500 cases. Of these, 13,000, that is 70 per cent, were malignant tumors. With regard to the results obtained, the cancers are divided into five large groups:

(1) Skin cancers. These are divided into superficial and infiltrating tumors. In the superficial tumors a healing of 86.3 per cent was obtained (88 out of 102 cases). If the cases which have not completed the treatment are excluded, the percentage is 95. In the infiltrating tumors, the cure was 51.4 per cent (54 out of 105 cases). If only the operable cases are taken into consideration the percentage is 67.5 (54 out of 80 cases).

By taking into consideration all cases of skin cancers coming under treatment, whether operable or inoperable, whether the treatment was completed or interrupted, the total percentage of cures is 68.6 (142 out of 207 cases). If only the operable cases are taken into consideration the percentage is 78.

(2) Lip cancers. These again are divided into superficial and infiltrative tumors. In cancers of the lower lip, of the superficial tumors 90 per cent were cured (36 out of 40 cases). In the infiltrative tumors the cure was 34 per cent (9 out of 26 cases); however, 54 per cent of these (14 out of 26 cases) were at the time of the treatment already inoperable. When only the operable cases are taken into consideration the percentage of cures is 75. Thus the absolute cures in all cancers of the lower lip are 68 per cent (45 out of 66 cases). If the 14 inoperable cases and the 6 cases which did not complete the treatment are excluded the percentage of cure is 86 (45 out of 52 cases).

In cancer of the upper lip the cure was 70 per cent (14 out of 20 cases). The 11 superficial tumors were all cured. Of the 9 infiltrative cases there were only 3, that is 33 per cent, cured.

In cases of cancer of the lower and upper lip with metastases to the lymph nodes the conditions are not so favorable. Of the 13 infiltrative recurrences following surgery with involvement of the lymph nodes not one single case was cured by the application of radiation therapy. Therefore all operable lymph node metastases should be extirpated.

(3) Cancers of the mouth. Two hundred and forty-four cases of cancer of the mouth (carcinoma linguae, carcinoma sublingualis, carcinoma mandibulae and carcinoma buccae) were treated by radiotherapeutic methods; some by radiation alone, others by combination with surgery. The number of cases treated by radiation alone was 160. Of these in 19 per cent (31 cases) there was one year cure; in 19 per cent there was three year cure, and in 18 per cent there was five year cure. The cases cured were all localized to the site of the primary lesion. In none of the 72 cases with regional lymph node metastases was there obtained even a one year cure. If only the operable cases are taken into consideration, the cures by radiation alone were: one year, 35 per cent; three years, 33 per cent; five years, 31 per cent.

In the cases where radiation therapy was combined with surgical procedures, there was 63 per cent one year cure (53 out of 84 cases); 64 per cent three year cures and 60 per cent five year cures. Therefore in the operable cases the number of cures is doubled with surgery and radiation therapy as compared with radiation therapy alone. The recurrence in both cases is practically zero following the first year in the one year cures so that in carcinomas of the mouth a one year cure is equivalent to a final cure. Still greater is the difference in the cases with regional metastases. Radium therapy alone has not produced a single case of healing, while the combination

of surgery and radiation therapy resulted in a one year cure of 37 per cent (10 out of 27 cases), three year cures of 35 per cent and, five year cures of about 30 per cent. In analyzing the results obtained in the combined method with regard to the anatomical distribution of the carcinoma, we find that: 59 per cent cancers of the tongue (13 out of 22 cases), 83 per cent sublingual cancers (5 out of 6 cases), 33 per cent cancers of the jaw (3 out of 9 cases) and 50 per cent cancers of the cheek (1 out of 2 cases) were symptom-free at the end of five years.

(4) Uterine cancers. (*a*) Cancer of the cervix. Of 541 cases of carcinoma of the cervix 112 were symptom-free at the end of five years, that is, an absolute cure of 20.7 per cent. If only the operable and borderline cases are taken into consideration the results of five year cures were 67 out of 145 cases, that is 46.2 per cent. (*b*) In the cancers of the body of the uterus, 20 out of 46 reached the five year period, that is, an absolute healing of 43.5 per cent. If only the operable cases are taken into consideration, the five year cure was 60 per cent.

(5) Sarcomas. Of the 543 cases of sarcoma, 181, that is 33 per cent, remained symptom-free at the end of five years. With regard to the method of treatment, the sarcomas can be divided into two groups: those in which radiation therapy alone was used and those in which radiation therapy was associated with surgical procedures. Of the 392 cases in which radiation alone was used, 238 were primary lesions and 154 recurrent lesions. Of the 238 primary lesions, 148 were inoperable, 58 of which have remained symptom-free after five years; that is, a percentage of 24. Of the recurrent or metastatic sarcomas 28 out of 154 remained well at the end of five years, that is, 18 per cent. Of the 151 cases where radiation therapy was associated with surgical methods, 95, that is 66 per cent, have remained symptom-free at the end of five years.

(6) Results in carcinomas where pre- or postoperative irradiation was applied. The number of cases treated was not sufficiently large to form a definite opinion with regard to the value of such a procedure. The importance of the combined method in carcinoma of the mouth and in some cases of sarcoma has already been mentioned. In carcinoma of the vulva the combined method, especially that of radiation therapy and electrocoagulation, has led to some truly remarkable results. Of the 26 cases treated by such a method, 8 have remained symptom-free.

In cases of carcinoma of the ovary it was noted that good results were also obtained in cases of incomplete operative procedures, 3 out of 7 cases remaining well over a period of five to twelve years.

Only 76 cases of carcinoma of the breast are on record where postoperative irradiation was applied following radical surgery. Of these cases, 47 (60 per cent) were symptom-free at the end of three years. The statistics of Nyström dealing with 572 cases of mammary carcinoma treated by operation alone between 1911 and 1913 showed that only 20 to 23 per cent of the cases were alive at the end of five years. Thus it seems that postoperative irradiation will aid in improving these figures.

(7) The palliative value of radiation therapy. Under "palliation by radiation therapy" is understood the local healing of the primary lesion. Here the absolute palliative value, that is, the frequency of a palliative result in all cases of malignancy treated and the relative palliative value, that is the frequency of the palliative effect of only those cases which have completed the treatment are considered.

(*a*) The results of absolute palliation are as follows: Of 4,470 cases treated a local healing was obtained in 1,714 cases, which gives a value of absolute palliation of 38.3 per cent. This result is remarkably high but it is explained by the fact that 2,131 cases were operable and that the skin, lip and uterine cancers are also included. In skin cancers, for example, the absolute palliative value is 78.3 per cent (625 out of 798 cases); in lip cancers 69.7 per cent (138 out of 198 cases), and in uterine cancers 45.2 per cent (513 out of 1,135 cases).

The above figures of absolute palliation could be still further improved by deducting such cases as cancer of the larynx, esophagus, gastrointestinal tract, bladder, hypernephromas, and brain tumors which are all considered more or less refractory to radiation.

(*b*) The results of relative palliation. Of the 3,354 cases where radiation therapy was completed a local healing of the primary lesion was obtained in 1,714 cases, thus giving a relative palliative value of 51.1 per cent. For the different groups of diseases this relative palliative value is as follows: For skin cancer 92 per cent (625 out of 678 cases); for lip cancer 78.4 per cent (138 out of 196 cases); for uterine cancer 57.6 per cent (513 out of 890 cases). In sarcomas 29.4 per cent (100 out of 340 cases).

If the palliation is considered only from the point of view of symptomatic improvement we find that of 3,335 cases of uterine cancers there was an objective improvement in 1,529 cases; that is, 45.9 per cent; in 935, that is 28 per cent, there was no improvement; 252 (7.5 per cent) did not complete the treatment,

and 619 cases, (18.6 per cent) were considered as unfit for treatment. Therefore in taking into consideration only the 2,464 cases where the treatment was completed, objective improvement was observed in 1,529 (62 per cent) of the cases. In 935 cases, that is 38 per cent, there was no improvement.

In analyzing other groups with regard to the value of palliative irradiation the author arrives at the conclusion that radiation therapy should be carried out in all forms of malignant tumors regardless of the stage of the progress of the disease.

The value of radiation therapy is considered also in warts, in angiomas and in Basedow's disease.

(1) Warts. No benefit was obtained in only 19 out of 1,187 cases. In multiple warts the treatment is often difficult and special attention must be given to overdosage when the warts are located on the sole.

In multiple warts and tylosis the author advises, in addition to radiation therapy, the administration of magnesium sulphate in a very weak solution (1 gm. three times daily for a period of two to three months). The author saw a case of very extensive papilloma of the larynx entirely disappear under treatment with magnesium sulphate alone. In certain types of warts psychotherapy (suggestion) is also of distinct value.

(2) Angiomas. Fifty-nine cases of deep cavernous, 138 cases of superficial cavernous and 76 cases of capillary angiomas were treated. The author stresses the importance of conservative expectant treatment. Only one dose of 80 per cent S.U.D. is applied and then the lesion is observed for several months. In 62 per cent of the deep cavernous, in 70 per cent of the superficial cavernous and in a great number of the capillary angiomas excellent cosmetic results were obtained by this expectant method. In the other cases treatment had to be repeated.

(3) Basedow's disease. Eighty cases of Basedow's disease were treated between 1918 and 1925. In 57 cases the treatment was completed. Out of these 57 cases, 30, that is 5.26 per cent, were cured. In 13 (22.8 per cent) there was remarkable improvement; in 5 (8.8 per cent) there was no improvement. It appears therefore that radiation therapy is of considerable value in the treatment of this disease. As compared with surgical indications it is recommended that cases with marked and rapidly developing symptoms be operated on, while cases with mild and only slowly developing symptoms be first treated by irradiation.—*T. Leucutia.*

Frey, Hans. Experimental investigations with regard to the roentgen sensitivity of the suprarenals. *Acta radiol.*, 1928, ix, 23–53.

The author analyses the most important publications of the literature dealing with the subject of the roentgen sensitivity of the suprarenals. The publications are classed into two different groups: (1) those dealing with the subject on the basis of the histologic findings. Here the works of Harvey, Decastello, Zimmern and Cottenot, Salle and Domarus, Strauss, Stephan, Lacassagne and Samssonow are considered. Especial attention is paid to the more recent publication of Holfelder and Peiper, as well as those of Schinz, Tsukamoto and Gabriel, these latter contradicting the experimental results of Holfelder and Peiper; (2) those dealing with the subject on other bases than histologic findings. The following three factors are especially considered: (*a*) the lowering of the blood pressure produced by irradiation of the suprarenals (Zimmern and Cottenot, Levy-Dorn and Weinstein); (*b*) the sugar content of the urine, and blood (Zimmern and Cottenot, Strauss and Rother), there being first a slight decrease then an increase in both the urine and blood sugar; (*c*) the adrenalin content of the suprarenal glands (Eisler and Hirsch, Hesse, David and Hirsch), very high doses of roentgen rays producing a decrease in the adrenalin content of the suprarenals.

From this very detailed review of the literature Frey arrives at the conclusion that there is quite a confusion and contradiction with regard to the results obtained. Generally speaking, one may say that most authors deny a special sensitiveness of the suprarenal glands towards irradiation, with the exception of Stephan and Holfelder and Peiper who maintain that the suprarenals are highly radiosensitive.

Frey undertakes numerous experiments to disprove the contention of Holfelder and Peiper. The observations were made on the basis of histologic findings, the following criteria having been used: (1) the structure of the nucleus and plasma of the hematoxylin-eosin colored specimens; (2) the chrom affinity of the irradiated and non-irradiated suprarenals; (3) the lipoid content of the irradiated and non-irradiated suprarenals, and (4) the quantitative histologic analysis determining the decrease or increase of certain tissue elements.

The following are the results of the experimentation: (1) The roentgen sensitivity of the suprarenal glands of male guinea pigs was tested by an irradiation of 100 to 500 per cent skin unit dose. The roentgen-ray exposure was

given directly over the back through a small portal of entry. The animals were killed within a period from a few days to three months following the irradiation and histologically examined. (2) Female guinea pigs are not suited for the experimentation since it is practically impossible to shield the ovaries during the irradiation, and, as is known, there is a correlation between the function of the suprarenal glands and of the ovaries. (3) By applying the doses described in (1) no changes could be observed from the direct effect of the roentgen rays except for a transient hyperemia and a slight increase in mitosis. There were no changes with regard to the structure of the nucleus and protoplasm of the cortical cells nor with regard to the chrom affinity and lipoid content of the cells. The quantitative histological analysis was also negative, at any rate there was no atrophy demonstrable. (4) Secondary changes were observed in few of the animals. Thus in one of the animals (out of 26 investigated) some changes were observed which might be described as due to the direct effect of the roentgen rays; however, on closer scrutiny it was found that they were only post-mortem changes. In 3 other animals there was some loss of weight. There was evidence of decrease in the lipoid content and an increase in the number of mitotic figures of the cells (twenty to twenty-four hours following the irradiation) but it was thought that both phenomena were the result of inanition rather than of direct effects of the roentgen rays. (5) Since there is no demonstrable evidence of an increased radiosensitivity of the suprarenal glands the so much stressed advice to protect the suprarenals during deep roentgen-ray therapy is without any foundation.—*T. Leucutia.*

Gabriel, G. The effect of roentgen rays on the kidney. *Strablentberapie*, 1927, xxvii, 601–602.

This is in reply to a criticism by Willis and Bachem of the author's work. In his work in irradiation of the kidneys he emphasized the early and intense changes in tonus of the vessels of the glomeruli, followed in later stages by contraction, proliferation of the capsule, hyalinization and cicatrization and hyperplasia of the elastica of the larger vessels, in addition to the changes in the epithelium in the terminal stages of contracted kidney. Willis and Bachem hold that the epithelium of the tubules is first destroyed and replaced by connective tissue and then the capillaries are obliterated, while the glomeruli remain practically unchanged.

Gabriel says that their objections to his conclusions are not valid because even in their findings there was considerable involvement of the vessels, and the experiments were not performed under the same conditions. He irradiated the kidneys in fractional doses without anesthesia and waited till the animals died. They gave a single large dose after exposing the kidney under ether anesthesia so that the earlier stages of change of tonus of the vessels did not become manifest.

Gaertner, O., and Klövekorn, G. H. The use of the specific irradiation of metals (homogeneous irradiation) for surface therapy. *Strablentberapie*, 1927, xxvii, 597–600.

For scientific purposes as homogeneous an irradiation as possible with a definite wave length is often desirable. The softer parts of a mixture of rays can be excluded by filtration but not sufficiently to produce anything like a homogeneous irradiation with the filters in ordinary use; but if a strong enough filtration is used to bring about a relatively uniform absorption coefficient, the homogeneity is secured at the expense of a large amount of energy which is absorbed in the filter.

Any anode material in addition to the irradiation of the continuous spectrum which it emits, which is dependent on the tube tension, has an irradiation of its own, the wave lengths of which differ for different metals. The proportion of this specific radiation to the total irradiation also differs. For tungsten and with the tension and filters commonly used it is very small as compared with the continuous spectrum irradiation. But there are other metals that could be used as anode material which within certain limits of tube tension even without filtration would produce an irradiation made up chiefly of short wave rays, the so-called K-irradiation. The proportion of this K-irradiation to the total irradiation is greater, the longer waved the specific irradiation is.

The authors have been experimenting for a year with the specific irradiation of copper, irradiating their own skin with different doses. They used a tube tension of 70 kv. to kill bacteria, but the maximum for use on the human skin is 40 kv.; with this tension the erythema time is 4.5 minutes with 23 cm. distance and 5 ma. The size of the circular field outlined by the Lindemann window at this distance is 80 sq. cm. With an irradiation of 380 R erythema occurred thirty-eight to forty hours after the irradiation. With an increase to 425 R there was an intense redness of the irradiated field in ten hours, vesicles developed in four more hours and in twenty-six to twenty-eight hours after the irradiation

there was an ulcer. This healed in one to two weeks without a scar, and after a year there is no change except that the area shows a slightly brownish color. The specific irradiation of copper in a Bucky borderline ray apparatus corresponds to an irradiation with a tension of 10–11 kv.

This shows that it is possible by this method to produce homogeneous irradiation of sufficient hardness for surface therapy with soft rays.

Glasser, Otto. Some problems in dosimetry. *Strablentherapie*, 1928, xxvii, 740–745.

As soon as the electrostatic "roentgen" units determined by the different laboratories agree, this unit can be used as an international unit for standard dosimetry. Solomon's definition of a roentgen unit is the same as an electrostatic unit if with the use of an air-wall chamber the distance from the radium to the chamber is decreased from 2 cm. to 1.37 cm. The roentgen unit obtained by combining the two roentgen units has the advantages of both and can be used as an international unit for roentgen-ray dosage. The air-wall chamber of Fricke-Glasser and Glocker is the small chamber of choice for practical dosimetry on account of its independence of wave length. The chamber should be gauged in roentgen units with reliable instruments in a gauging laboratory. Such a small chamber with a volume of about $\frac{1}{50}$ c.c. is recommended for the preparation of tables of deep dosage and for the construction of a uniform dosimeter. This would make it possible to measure dosages from the softest roentgen rays that are used in practice to the gamma rays of radium in the simplest possible way. The use of standardized small chambers at the place where the rays are applied would solve the problem of practical measurement of therapeutic doses in roentgen units.

Glasser, Otto, and Beasley, I. E. Dosimetry of the borderline rays with the Wintz-Rump photometer. *Strablentherapie*, 1928, xxviii, 611–614.

The Wintz-Rump photometer for measuring the dosage of very soft rays is described. Dosimetry is particularly important with these rays because of the great variations in the yield of different tubes and forms of apparatus. The authors themselves devised a small chamber made of goldbeater's skin for the measurment of these rays as they are absorbed only very slightly by goldbeater's skin. Comparative measurements with the two apparatus showed that the photometer is accurate within 10 per cent and the chamber of goldbeater's skin within 5 per cent. The Wintz-Rump photometer is reliable for the dosage of the borderline rays within the wave lengths now in use. It can be used for comparative measurement or after gauging in R units as an absolute dosimeter for borderline rays.

Glasser, Otto, and Seitz, V. B. The condenser-dosimeter. *Strablentherapie*, 1928, xxix, 549–555.

A new instrument, the condenser-dosimeter is described and illustrated. By its use it is possible to measure ray dosages over a wide range of wave lengths, from 3 to 0.02 Å.

Grebe, L., and Gaertner, O. The absolute determination of the R unit at the Bonn Roentgen Institute. *Strablentherapie*, 1928, xxvii, 728–733.

Such determinations are of interest because of the discrepancy between the German and American measurements. The method used at the Bonn Institute is based on the use of a large ionization chamber which is filled with air at atmospheric pressure; it was shown that the utilization of the electron method of ionization was complete within the limits of error. The dimensions of the cylindrical chamber were 190 mm. length and 250 mm. diameter. A diagram of the internal arrangement of the chamber is given and the method of making the measurements described in detail. There is a possible error of 0.3 per cent in measuring the tension, of 0.4 per cent in measuring capacity, of 0.3 per cent in measuring the distance, of 0.2 per cent in measuring the length of the chamber and of 0.6 per cent in measuring the surface of the diaphragm. The sum of all these possible errors is 1.8 per cent so the probable error is not more than about 1 per cent. The absolute measurements determined in this way were transferred to Göttingen and agreed within 1 per cent with the absolute measurements made there.

Hase, H., and Küstner, H. Accuracy of gauging by the three electrometer method. *Strablentherapie*, 1928, xxix, 730–744.

The sources of error in gauging with the two electrometer method are discussed and methods described of decreasing them as much as possible. There are sources of error in measuring the focus distance, ones due to action of irradiation from the pedicle to oblique position of the filter, difference in the thickness of the filter, difference in the thickness of the tube wall and weakening of the roentgen radiation by air. Even with the most

careful correction, errors of several per cent must be counted on from these sources. These sources of error are overcome by the three electrometer method. The method is described and illustrated and its accuracy shown by the protocol of one apparatus. It is shown experimentally that in a case of very erroneous diaphragming of the source of rays the two electrometer method gave an error in gauging of 50 per cent while the three electrometer method gave one of only 1.6 per cent.

Hase, H., and Küstner, H. Standardizing the r unit. *Strahlentherapie*, 1928, xxix, 745–758.

Standardization of the r unit is of great value as any variation in it in gauging dosimeters is transferred to them. It can be standardized by repeated absolute determinations or by radioactive preparations. Five absolute determinations are reported, one of them on a small, one on a large chamber, and three on gauging apparatus of different sizes. All the results agree within 2 per cent. Continuous controls with 2 beta ray preparations and 2 gamma ray preparations are reported. All the controls agreed splendidly. The material shows that the probable error in the individual controls for beta rays is 3.3 per cent, for gamma rays 0.65 per cent. The control by absolute determination takes more time than the rapid and convenient control by the radioactive method, so it is advisable to use the latter ordinarily and the former from time to time. This method of double control gives double security in standardizing the r unit. It is shown that a dosimeter gauged without radioactive control of the gauging apparatus may give an error in dosage of 11 per cent.

Hase, H., and Küstner, H. Measurement of dosage in r units with the gauging apparatus within the range of hardness used for skin therapy and diagnosis. *Strahlentherapie*, 1928, xxx, 86–112.

The great extent to which the dosimeters in use at present are dependent on hardness in the range of hardness used in skin therapy and the great difference in the hardness of the mixture of roentgen rays caused by differences in the thickness of the glass of the tube make accurate dosage in r units in skin therapy impossible. Accurate dosage and absolute determination of the r unit for all mixtures of rays from glass tubes was therefore worked out with the aid of the gauging apparatus. The method was based on the proportion between the weakening of the roentgen rays in 1 mm. cellose and in air. Different methods of examination agree quite well in showing that 1 mm. cellose weakens roentgen rays of every degree of hardness and homogeneity as much as 109 cm. air. The hygroscopic properties of cellose have no effect on the results.

Experimental comparison of different types of gauging apparatus with a giant chamber without a material window agree perfectly with the theory and show that dosage can be determined in r units with the gauging apparatus for all kinds of rays from glass roentgen tubes. The gauging apparatus only shows a range of hardness of at most 13 per cent between the irradiations used in deep therapy and the softest irradiation from glass tubes. A method is described on the basis of measuring the weakening in cellose, that makes it possible to exclude not only this small range of hardness of the gauging apparatus but also the weakening of the roentgen rays by the air in the distance between the skin of the patient and the gauging apparatus.

It is shown that differences which occurred in the gauging of the first apparatus with a soft irradiation of 60 kv. unfiltered rays were caused by weakening in the air due to different focus distance. A calculation of this weakening in the air reduced all the results to the same value. This proves the correctness of the method. It was shown experimentally that the use of too thin a window in the chamber may lead to great errors in measurement because electrons set free by the roentgen rays at the edges of the diaphragm penetrate the thin window, enter the chamber and cause additional ionization.

Hausmann, W., and Pauli, W. E. The effect of cathode rays on erythrocytes. *Strahlentherapie*, 1928, xxx, 350–358.

Blood agar plates were irradiated with cathode tubes and rings of hemolysis appeared around the outer edges. The erythrocytes in the center of the ring were not hemolyzed. They had also become resistant to saponin which has a very strongly hemolytic action. The reason for this increased resistance of the erythrocytes in the center of the plate is discussed but no definite conclusions are reached.

Heim, Konrad. Biological effects of roentgen rays on hens' eggs and organ explants. *Strahlentherapie*, 1928, xxvii, 694–710.

A single irradiation of fertilized hens' eggs with a hard filtered homogeneous irradiation up to 500 r immediately before artificial incubation always caused considerable disturbance in the development of the embryos, varying from general inhibition of growth and delay in maturing to pronounced malformation or increased number of early deaths of the

fetuses. The degree of injury seemed to be dependent on the dose. If the same amounts of radiation were applied during the first days of incubation the same kind of disturbances in the course of development were noted. But the later in the incubation period the irradiation was given, the less its morphological effects seemed to be.

Attempts to bring about functional changes in the cell reactions by explanation experiments with tissues of irradiated embryos did not give uniform results. Irradiation of the ovaries of hens caused a cessation of laying for a time, but the eggs after laying began again did not show any anomalies in the development of the fetus for a period extending over five months with the same irradiation during incubation, or at least none that could be interpreted as due to definite injury of the germ plasm. But the possibility of inherited injury is not yet excluded; it will require further experiments for that.

Hens' eggs are particularly adapted for experiments in testing the biological action of rays because the eggs and embryos are especially sensitive to physical effects and because the development of the fetuses can be followed up easily.

Hess, P. The erythema dose and the Sabouraud unit. *Strablentberapie*, 1928, xxix, 803–805.

A comparative measurement of Sabouraud and Holzknecht units gave a constant proportion of 1:4. With hard and moderately hard radiation an erythema dose of 700 R corresponded to an average value of 10 H units. In surface therapy the erythema dose measured by the Sabouraud method is ⅕ the R erythema dose so in using R units in skin therapy not more than ⅕ of an erythema dose should be given at one treatment.

Hess, P. The R dose required to produce equivalent erythemas with different qualities of rays. *Strablentberapie*, 1928, xxvii, 734–739.

The Bonn Roentgen Institute determined the doses of different qualities of rays required to produce equivalent degrees of erythema, using accurate physical methods of measurement and found physical doses that varied only a little from 700 R for all the different degrees of hardness. The biological experiments were repeated with a physical dose of 700 R and these experiments confirmed the fact that the dose required to produce erythema is the same for all degrees of hardness of rays. The variations found before have been due to a secondary irradiation dependent on the quality of the tubes used, as the measurements were made under the ordinary conditions of daily practice. As the R dose is independent of hardness only for the absorbed or biologically effective dose, the author proposes using this as the foundation of dosage instead of the physical dose, as it would simplify physical dosage considerably.

Ingber, E. Radium sensitiveness of Actinomyces. *Strablentberapie*, 1928, xxviii, 581–588.

Cultures of *Actinomyces bovis* were irradiated by a special method of suspending them in a net of violin strings around the mesothorium capsule under a glass bell in order to avoid the possible slight effect of the glass of the test tube. The experiments showed that mesothorium at first in doses of 600, 1200 and 1800 mg-hr. favors spore formation and that the optimum effect is reached at 1800 mg-hr. On giving a dose of 3600 mg-hr. a slight inhibition of spore formation can be seen macroscopically, though the time of development remains the same. Microscopically there is a decrease of the thallospores produced by mature mycelia and the mycelia are very much branched. The last photomicrographs with a dosage of 10,575 mh-hr. show a condition of paralysis of the microorganisms; the mycelia increase in length and show few reproductive cells. These properties disappear slowly but surely in the succeeding generations. This shows that even a dose of 10,575 mg-hr. does not kill the microorganisms; it only brings about a condition of paralysis which is temporary, and the intensity of growth and reproduction of the Actinomyces are only slightly weakened.

Jacobi, Hans, and Liechti, Adolf. Tension, filtration, half-value layer and depth dose in deep therapy. *Strablentberapie*, 1928, xxix, 503–523.

The use of the spark gap in measuring all the tensions used in diagnosis and treatment is discussed and found reliable if the necessary precautions are used, and the dependence of the half-value layer on tension and filtration is shown in the form of curves. It is shown that the half-value layer is practically independent of the type of tube and the form of the current and dependent only on tension and filtration if the strength of the walls of the tubes is made uniform. The normal thickness of the wall is assumed to be the maximum used in the making of tubes, equivalent to 3 mm. aluminum, and all the curves are based on this value.

Direct determination of the half-value layer is pronounced the surest way of measuring quality. But in deep therapy the distribution

of the intensity in the body can be determined practically without any great error from the tension and the thickness of the filter. It is shown that the deep dose is dependent on the half-value layer and to a certain extent on homogeneity, but independent of the form of the current. This dependence is shown in the form of curves. A simple definition of the degree of homogeneity adapted to quality is given and compared with Christen's quotients of the first and second half-value layers.

Jacobi, H., and Liechti, A. Measurement of the quality and intensity of secondary radiation. *Strahlentherapie*, 1928, xxvii, 711–727.

Experiments are described in measuring the change in quality of the rays on being weakened by 20 cm. water; in measuring the difference in quality of pure secondary radiation from different materials and in measuring the quality of weak primary radiation plus secondary radiation at different depths of water. The results are given in the form of curves.

The secondary radiation for five irradiations and different sizes of field was measured with two chambers independent of wave length, both on the water phantom and for two irradiations on patients. The R dosage required for the production of skin erythema over fields of different sizes is given in the form of curves for five different irradiations. The results of the secondary radiation are also given in curves.

Kerl, Wilhelm. The position of roentgenology in medicine. *Strahlentherapie*, 1928, xxix, 207–211.

The history of roentgenology from the first discovery of the rays by Roentgen in 1895 is briefly reviewed. When it was first found that the rays were valuable for therapeutic purposes individual physicians tried to provide themselves with roentgen apparatus but technical improvements were made so rapidly that the apparatus was quickly out of date and the cost of keeping up with the changes was too great to be borne by the individual, so roentgen treatment became limited chiefly to the large institutions. Now however the author thinks a change is taking place and will continue. Technical changes are not being made so rapidly, and roentgenology is becoming a necessary part of every physician's equipment. The diagnostic use of roentgen rays may be compared with the use of a microscope. It would be absurd for the physician to have to send his specimens to an institution for microscopic examination and a diagnostic roentgen apparatus is now just as necessary as a microscope. This, of course, does not minimize the importance of the roentgen institutes in research and leadership in roentgenological practice.

Kessler, E., and Sluys, F. The space distribution of gamma radiation and its measurement for therapeutic purposes. *Strahlentherapie*, 1928, xxix, 385–402.

So long as only small amounts of radium were available and it had to be introduced inside the tumor it was not possible to do more than calculate the dosage, but when more radium was available and methods were devised for applying it from outside the body the necessity for measurement became more urgent. The author describes and illustrates his apparatus for determining the distribution of intensity of the irradiation, giving the lines of isodosage in some special cases. The apparatus consists essentially of 13 localizers fastened on a shell of aluminum and while the method is imperfect and troublesome it represents an advance in the measurement of distant radium treatment.

Klövekorn, G. H. Dosage of borderline rays in R units. *Strahlentherapie*, 1928, xxix, 190–191.

A physically exact dosage is only possible with Küstner's gauging apparatus, a short chamber being added as an attachment for borderline rays. It was found by experiment that the primary kilovolt number cannot be used in reporting the measurement of borderline rays because irradiations of different intensity and different degrees of hardness are obtained on the same apparatus with different tubes in spite of using the same number of kilovolts. So it is desirable in all reports of borderline rays to give the quality of the rays as a half-value layer in cellon, water or aluminum, or as weakening in cellon and also the quantity in R units. In the author's experiments in determining the R units required to produce borderline ray erythema he found that erythema occurred after seventy-two hours with a quality of rays which on passing through 0.2 mm. cellon showed a weakening of 32 per cent (10 kv. and 10 ma.). The amount of rays used was about 1480 R. With a weakening of 27.5 per cent through 0.2 mm. cellon (9 kv. and 10 ma.) the erythema was produced in the same time with 1630 R.

Klövekorn, G. H., and Gaertner, O. Roentgen rays and unicellular organisms. *Strahlentherapie*, 1928, xxix, 773–778.

The effects of ultraviolet rays and gamma rays on bacteria and amebae are considered

in this article; the effects of roentgen rays have been treated in a previous one. *Staphylococcus aureus* was used as a representative of the cocci, the colon bacillus as a non-spore bearing bacillus, *Bacillus mesentericus* as a spore bearing bacillus. For the radium experiments 15 mg. radium filtered through 1.0 mm. brass was used; it was hung 5 mm. above the cultures. After four hours' irradiation there was a decrease of growth but the bacteria were not killed. The same surface was then irradiated with 70 mg. radium; after one to two hours' irradiation there was a decrease in the number of the bacteria but they were not killed. The longest irradiation time was forty-eight hours, or 3360 mg-hr.; absolutely all the bacteria were not killed even then. This was pure gamma radiation; probably smaller amounts would be required if beta rays were used also. The tests on fresh water amebae were made in the same way. After an irradiation of four hours with 70 mg. radium most of the amebae were living, though swollen and not very active. Experiments with different kinds of media showed that the medium was not of decisive importance.

The previous experiments showed that roentgen rays are more bactericidal. They differ from the other rays tested in not occurring in nature. The author questions whether it would not be possible to bring about a sort of adaptation to roentgen rays, that is, whether by keeping them under the constant influence of weak roentgen irradiation for a long time they might not gradually become habituated to it.

Kovacs, K. The effect of roentgen rays on diffusion and permeability of the cell membrane. *Strahlentherapie*, 1928, xxx, 77–85.

Experiments on frogs are described which show that the permeability of cell membranes and the diffusion of stains is visibly increased by the action of roentgen rays. The irradiation evidently causes a shifting of the electrical charges of the membrane by acting on the ions, which causes increased permeability. As to the bearing of these facts on treatment, the stimulant action of the rays, used in the treatment of bronchial asthma, irradiation of the spleen, etc., is similar to the effect of activation of protoplasm. Apparently the increased permeability of the membranes leads to absorption of albumin bodies that are not entirely assimilated, so that a foreign albumin action is exercised. It is probable that not only albumin but also carbohydrates, fats, lipoids, etc., may activate protoplasm when they are absorbed in unusually large amounts and more rapidly than usual, as they can be when permeability is increased. The destructive action of the rays, as utilized in the treatment of cancer for instance, is probably brought about by dehydration (contraction, breaking down of the nuclei). It has been shown that short wave rays have a powerful effect on the distribution of water by changing the degree of dispersity of the colloids. The experiments described above show that in all probability the chief point of action of the rays is on the colloids. The changes in the colloids and the changes in permeability and diffusion caused by them bring about conditions which explain the action of the rays better than any of the other current theories.

Küstner, Hans. Dosage of Bucky's rays with the gauging apparatus. *Strahlentherapie*, 1928, xxx, 334–342.

Curves and tables are given showing that in spite of the same number of kilovolts different tubes give irradiations of different intensity and different degrees of hardness, because of the varying thickness of their Lindemann glass, as thick Lindemann glass absorbs more of the soft components than a thinner glass. Air itself acts as a homogenizing filter for rays as soft as these and hardens them according to the law of roentgen absorption. The rule of the square of the distance does not hold good for them. For reasons of intensity as well as hardness the Bucky rays must always have the dosage determined with the same focus distance that is to be used in irradiation. There is satisfactory agreement between theory and experiment both as to the course of intensity and the weakening of the rays in Lindemann glass, and the doubtful factors can be determined with sufficient accuracy to meet the requirements of dosage in practice.

Lampa, Anton. The first theory of roentgen rays. *Strahlentherapie*, 1928, xxix, 212–220.

Roentgen examined his new rays systematically for properties that would classify them with one or another of the different kinds of rays. He found that they showed some properties of electromagnetic and some of corpuscular irradiation, so that they could not be classified unconditionally with either group. He conceived of the idea, therefore, that his rays might be due to longitudinal vibrations in the ether, though he admitted that this theory required further proof. Boltzmann carried the study of this point further, but his considerations are all theoretical and he has not given sufficient proof of the theory. He explains the physical relation between roentgen and cathode rays theoretically by considering them both as longitudinal waves, the cathode

rays having the shorter wave lengths; but he does not take up the point, which is important for his theory, that cathode rays can be deviated magnetically and electrostatically and roentgen rays cannot. The explanation of this obscure point is left for the future.

The author concludes that the theory of longitudinal waves in the ether does not explain roentgen rays; the explanation seems to lie rather in the direction of the corpuscular theory of cathode rays.

Lazarew, N. W. Further examinations of functional changes in the blood vessels after roentgen irradiation. *Strablentberapie*, 1928, xxix, 602–607.

Experiments are described which show that on roentgen irradiation of the rabbit's ear with doses that cause epilation or pronounced inflammatory reaction, in some cases followed by atrophic changes in the skin, the vessels of the irradiated ear for a considerable time after the irradiation show a more or less pronounced weakening of the reaction to toxins, and the tendency of the vessels to constriction is decreased. These results confirm those of pharmacodynamic examinations of the skin which showed that for three months to four years after irradiation of the human skin with doses of ⅔ to 1 skin erythema dose there was a decrease of the skin reactions in the irradiated region to intracutaneous injections of adrenalin, caffein and morphin. Before that Löhr had noticed that skin injured by roentgen rays did not become paler on the intracutaneous injection of adrenalin. It is probable that the decreased constriction of the vessels in these experiments is due to regenerative changes in the vessel walls and their muscles such as have been described by various authors. Morphological changes, including injury of the endothelium, have been described in both arteries and capillaries for a long time after roentgen irradiation.

Lieber, G. D. Physico-chemical action of roentgen rays in the organism. *Strablentberapie*, 1928, xxix, 139–151.

It has been shown in previous work that the epilation brought about by roentgen rays is accompanied by changes in the potassium and calcium content of the hair follicles and that in the epidermis which is cast off there are also changes in the amounts of these two substances. But at that time only non-irradiated skin and skin after epilation was examined. The author has now made continuous series of examinations from non-irradiated skin through the process of epilation and until the hair grew again, and noted the microchemical changes. He found continuous changes in the calcium and potassium content from the time of irradiation up to the time the hair fell out and the epidermis was desquamated. Before regeneration began these changes began to be reversed until when the hair grew again the original condition had been restored. The fact that these changes precede the restoration of hair and skin indicates that the permeability of membranes is affected by the roentgen rays. As potassium and calcium are antagonistic substances they are very well adapted for such studies as this. The experiments all showed that the microchemical method is a reliable one. No differences were seen in different individual animals.

Lindblom, Adolf F. A roentgenological study of the blood distribution in rabbit lungs during treatment with artificial pneumothorax. *Acta radiol.*, 1928, ix, 147–154.

The question of the circulation of the blood in a compressed lung by artificial pneumothorax was repeatedly studied by experimental physiological and experimental pathological methods. The experimental physiological methods have included the estimation of the rate of flow of the blood (in situ and after extirpation) in different degrees of compression, or the registration of the blood pressure in the pulmonary artery (thus determining the resistance of the blood vessels of the compressed lung), or finally plethysmographic methods.

The experimental pathological investigations were carried out by killing the animals after the production of artificial pneumothorax and then determining either the total amount of the blood in each lung or the histological quantity of the blood in the sections from various portions of the lungs. That such methods led to erroneous conclusions is self-evident. Therefore the author proposes to determine the conditions of blood circulation in the compressed lung by means of the injection of opaque media. Several media were tried, such as heavy metal salts, barium sulphate, and concentrated tetraiodophenolphthalein, but they all proved either too toxic or did not give sufficient contrast. Then, a 25 per cent solution of lithium iodide was tried. This proved non-toxic but not of sufficient contrast; finally a 50 per cent solution was used with excellent results both with regard to non-toxicity and to contrast. The injection of the lithium iodide solution was made intravenously in one of the ear veins (in a few cases in the renal vein), 2 to 5 c.c. being injected within five to ten seconds. Roentgenograms

of the lungs were taken during the injection as well as immediately following the injection at one to two second intervals.

The following observations were made: (1) The blood distribution and the vascularization of both lungs is alike under normal conditions. (2) The compressed lung by artificial pneumothorax shows a smaller amount of blood than the opposite normal lung. There is no evidence of stasis in the compressed lung. (3) The slightest modification in the method of examination (even such as narcosis) produces marked changes with regard to the distribution of the blood in both lungs, thus leading to erroneous conclusions. (4) There is a marked change in the blood distribution and filling of the blood vessels at the time of death so that postmortem findings are not applicable to conditions in vivo.—*T. Leucutia.*

Lundqvist, Arvid. The arrangement of a dark room in roentgen departments. *Acta radiol.*, 1928, ix, 65–97.

Different plans are given for the most economical arrangements of dark rooms. It is the author's contention that the purpose can be best served by having two separate dark rooms. Slate is recommended as the most suitable material for covering all tables used in the dark room. The advantages and disadvantages of dish and tank developing are discussed. The article deals with technical details with regard to the arrangement of the different dark room accessories.—*T. Leucutia.*

Lundqvist, Arvid. On special protective arrangements in the handling of radium containers. *Acta radiol.*, 1928, ix, 119–125.

In the application of radium plaques in superficial therapy tinfoil is used as wrapping in order to facilitate cleaning after use. Two devices are described for the mechanical wrapping of the tinfoil, one for tubes and one for plaques. By this method the operator's hands do not come in actual contact with the radium and thus he is protected from unnecessary exposure.—*T. Leucutia.*

Meyer, W. H., and Braestrup, C. B. Determination of the quality of roentgen rays. *Strablentherapie*, 1928, xxix, 543–548.

The authors recommend determination of the half-value layer in aluminum as the best method of measuring the quality of roentgen rays and give reports on the practical use of this method. They also show the effect of the quality of the rays on the epilation dose.

Motojima, R. Experimental study of the action of different kinds of rays on the vessels of the frog's tongue. *Strablentherapie*, 1928, xxx, 343–349.

Irradiations of the vessels of the frog's tongue with light, radium and roentgen rays all caused dilatation of the vessels, slowing of the current, congestion, diapedesis and edema. But there were differences in the course of the reaction. The effects appear quickest on ultraviolet irradiation and pass off quickest. The more intense the irradiation, the longer the changes last. The reaction to soft beta rays appears more quickly and lasts longer than that to filtered radium rays. On ultraviolet irradiation and irradiation with naked thorium x rods (soft beta rays) in addition to dilatation of the vessels, extravasation of red corpuscles is more marked than after weakly filtered radium radiation (gamma rays and hard beta rays); this reaction was least to roentgen irradiation. After a roentgen or radium irradiation the latent period changes; the vessel reaction to a second irradiation takes place in a few minutes. After the vessel dilatation following a roentgen or radium irradiation has receded a second wave of dilatation may take place a few days later in the irradiated region.

Podljaschuk, L. D. Experimental study of the relations between the hypophysis and the other glands of internal secretion. *Strablentherapie*, 1928, xxx, 65–76.

Experiments in the irradiation of young and adult dogs and young rabbits are reported. The experiments on sexually mature animals showed that exclusion of the glandular parts of the hypophysis caused a series of disturbances in the organism, particularly changes in the endocrine system. The degree of the changes depended to a certain extent on the size of the dose, but not strictly. Sometimes quite unexpected changes occurred which were evidently not due to the size of the dose or to endocrine relations but to individual peculiarities. But no changes were brought about in the ovaries and testicles.

The experiments on young animals showed that partial exclusion of the glandular part of the hypophysis causes disturbances in metabolism and general development, and changes in the endocrine glands, their degree doubtless depending on the size of the dose. In a previous series of experiments atrophic changes were found in the ovaries after such exclusion but in these experiments there was only inhibition of development of the follicles but no process of degeneration.

The experiments as a whole show that the question of the relations between the hypophysis and the genital glands is by no means

settled yet, nor is that of the mutual relation of the glands of internal secretion in general, and there is no reason to assume a specific relationship between the hypophysis and the sex glands. There is not sufficient experimental evidence in support of the method of hypophyseal castration.

Polák, E. The effect of radium emanation on the blood vessels. *Acta radiol.*, 1928, ix, 169–205.

I. *Roentgen rays, radium rays and the autonomous nervous system.*

The author gives a very detailed review of the publications dealing with the effect of different radiations on the autonomous nervous system. From an analysis of the experimental results with regard to the production of the skin erythema as well as of other experiments dealing with the action of the roentgen rays on other vegetative functions one arrives at the conclusion that the effect of the roentgen rays on the autonomous nervous system is neither vagotropic nor sympathicotropic; it is most probable that the effect on both constituents of the vegetative nervous system is either by a direct action on the vital nerves or indirectly by the production of secondary albuminoid degeneration resulting from a deleterious action of the roentgen rays upon the cells. It is very difficult to determine in the case of roentgen rays how much of the change produced is due to the primary and how much to the secondary action. Parabiotic experimentations might eventually lead to more satisfactory results as indicated by Zacherl. In referring to Zwaardemaker's experiments, especial attention is called to the fact that both potassium and beta radiation have a direct action on the vagus, and that this action is of a similar character. But since the application of radium emanation produces symptoms of a stimulation of the sympathicus, while the administration of potassium and beta radiation has an inhibiting effect, it is suggested that an antagonistic action, similar to the vagosympathetic antagonismus, exists also between the alpha and beta radiation. From this the author deduces the hypothesis of the sympathicotropism of the alpha-particles.

II. *The author's own experiments with regard to the action of radium emanation on blood vessels.*

In order to prove the above hypothesis of the sympathicotropism of the alpha-particles, the author has carried out several experiments with regard to the action of ergotamine on the blood vessels of frogs. The following are the results: (*a*) Radium emanation acts as a vasoconstrictor. The spasm of the blood vessels produced is transitory and in comparison with the vasoconstriction caused by adrenalin and ergotamine is of lesser intensity (first series of experiments). (*b*) Ergotamine also develops vasoconstriction in frogs. A second vasodilatatoric phase is only exceptionally observed. Preliminary administration of ergotamine neutralizes or even reverses the adrenalin action even in the Laewen-Trendelenburg preparation (second and third series of experiments). (*c*) A summation of the adrenalin and emanation effect does not occur with the Laewen-Trendelenburg preparation. However it was observed that if ergotamine was previously administered radium emanation produced a vasodilatatoric effect. This reverse action of the emanation in association with ergotamine is probably similar to the one observed with calcium and already described by the author elsewhere (fourth and fifth series of experiments).

III. *Epicrisis.* In analyzing the practical value of the above experiments we find that they have a certain importance with regard to the therapeutic application of emanation. Vaňýseks and Prusik thought that because of the positive sympathicotropism, emanation could be used as a therapeutic agent for certain diseases of blood vessels. The author points out that a therapeutic effect from the radium emanation on blood vessels can be expected only in the case where the disease is caused by a toxin such as would produce a reversal of the emanation reaction similar to that of ergotamine action. Otherwise the vasoconstrictor effect of the emanation would produce more harm than good. An aggravation of the disease following adrenalin does not form an indication for emanation therapy, for adrenalin and radium emanation have a similar and not an antagonistic action upon the sympathetic. Therefore one has to wait for other criteria. It is possible that a more accurate knowledge of the toxic changes produced within the blood vessel walls will lead to a more rational use of the emanation as a therapeutic agent.—*T. Leucutia.*

Rajewsky, B. The reaction of albumin to irradiation and the production of erythema. *Strahlentherapie*, 1928, xxix, 759–772.

Theoretical and experimental methods of determining the primary fundamental process in the biological action of roentgen rays are reported. An experiment in vitro in determining the coagulation of albumin for the purpose of following up the mechanism of the action of the rays on living tissue is described. The action of the rays in this experiment ran parallel with the known course of production of erythema by short-waved ultraviolet light. A theoretical interpretation of the albumin coagulation by irradiation is given and supported by experimental results.

RAJEWSKY, B., and GABRIEL, G. Examinations of very soft roentgen rays. *Strablentberapie*, 1928, xxx, 308–333.

The methods of production of very soft roentgen rays from 8 to 12 kv. were examined, the investigation extending to their physico-biological properties. The investigation showed considerable discrepancies in the scale of gauging the tension with different apparatus. It was also found that they are not produced solely at a tension of 9 kv., the tension first reported by Bucky, as there were no specific physical properties or biological effects for rays produced at just this tension. The measurements of absorption with a special soft ray ionization chamber within the tensions mentioned above confirmed and explained the observations formerly made with the use of constant tension. And the observations on erythema also confirmed previous opinions as to the origin and peculiarities of the erythema produced by these rays. The soft rays affect the capillaries in the vascular layer. This effect is greater for the soft rays than for hard ones as a result of the conditions of absorption. Erythema develops when sufficient amounts of the rays act on the vascular layer; it is not produced by reflex action. Methods of dosage are discussed and some results of measurements of quality and quantity reported.

RUMP, WALTHER. The scattered radiation of the air. *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1928, xxxviii, 58–67.

Our knowledge with regard to the scattered radiation of the air is very meager. Nadaud estimated the scattered radiation as being 17 per cent of the primary radiation. Later Lorenz and Rajewsky estimated the value of the scattered radiation of the air as high as 24 per cent, while more recently Eugster and Zuppinger calculated only 5.9 per cent. In an earlier article Wintz and Rump obtained still lower figures (0.5 per cent), and Chantraine arrived at the conclusion that for practical purposes the scattered radiation of the air could be entirely neglected.

The great discrepancies among these figures (from 0 to 24 per cent) prove that the problem is far from being satisfactorily solved. Rump, after analyzing the errors committed in the above measurements, through measurements of his own arrives at the final conclusion that the intensity of the scattered radiation of the air is less than 1 per cent of the intensity of the primary radiation. The direction of the scattering is according to Compton's law.

It appears therefore that the scattered radiation of the air is of no significance in dosimetric measurements but that it has a certain importance in the estimation of protective means.—*T. Leucutia.*

SARALEGUI, J. A., and VIERHELLER, F. The quantity and quality of secondary roentgen radiation and its effect on the quantitative and qualitative distribution of the total irradiation in water. *Strablentberapie*, 1928, xxix, 556–580.

A method is described which makes it possible to measure the secondary radiation of a roentgen primary radiation, defined by its average wave length, in water separately from the primary radiation. The calculated quantitative results agree with those observed. With both large and small cones of rays there is a maximum of energy at about 1–2 cm. depth which increases with the volume irradiated. For the secondary radiation alone within the central ray this maximum lies at about 3 cm. depth and for a larger cone appears to move nearer to the surface. The action of the primary and secondary radiation together moves the maximum to about 1–2 cm. depth. The quality of the total irradiation remains constant from about 4 cm. on but for the primary radiation used it is about 10 per cent less than the latter.

SARTORY, A., SARTORY, R., and MEYER, J. The roentgen-ray tolerance of animals previously submitted to a lipoid-genetic regime. *Bull. Acad. de méd.*, July 17, 1928, c, 856–858.

In a previous publication the authors succeeded in demonstrating that it is possible to increase the output of the endogenous lipoids by the administration of albuminoid substances exercising a stimulative action on the biliary secretion. Thus, the results of Goodman, on the one hand, and those of Chauffard, Laroche and Grigaut, on the other hand, were confirmed.

In the present article the authors propose to demonstrate the influence and the modification produced by the roentgen rays on the normally fed animals and on animals receiving simultaneously a daily dose of 0.05 to 0.2 gm. "cytose" (secondary albuminose) for a period of six to eight days. The authors' contention is that the pathological phenomena caused by the roentgen rays are primarily due to an over-stimulation of the living intracellular substance and that they depend on the disturbance of equilibrium produced on the Donnan membrane, causing thus a diminution of cellular permeability.

Experiments on Mice. Ten normally fed mice used as controls and 10 mice fed with cytose for a period of six days were subjected

on the seventh day to a dose of roentgen rays, the technique of exposure of which was as follows: 23 cm. spark gap, no filter, dose 15 H (measured by the Sabouraud pastille). All controls died within seven to ten days following the roentgen-ray exposure from radiation intoxication, while all cytose fed mice survived.

The experiment was repeated three times with the same results.

In another series of experiments the maximum tolerance dose was determined. Five control mice and 5 cytose fed (0.05 gm. for six days) mice were subjected to a dose of 20 H by using the same technique of exposure. The control animals died within three to five days following the irradiation; the cytose fed mice all survived. Then the experiment was repeated with 30 H. Here all animals died, but the cytose fed animals survived forty-eight hours longer.

Experiments on Rabbits. Rabbits were chosen because of their larger size, thus enabling the application of more penetrating roentgen rays.

Two control rabbits and 2 cytose fed (0.2 gm. daily for eight days) rabbits were subjected to the following irradiation: 200 kv., 0.5 mm. Cu plus 1 mm. Al as filters, 250 R (Küstner), corresponding to 800 French R (Solomon), and the epilation was observed. The control animals started to epilate the fifteenth day following the roentgen-ray exposure and on the twentieth day the epilation reached its peak. The cytose fed rabbits showed no signs of epilation.

Conclusions. The ingestion of substances with a secondary albuminose base (prepared according to the technique of Scheitlin) has an inhibiting action which is the same for the chemical substances known as protoplasmic poisons and the roentgen rays which are physical agents.

Since there is an inhibiting action of the cytose against the protoplasmic poisons—probably due to the over-stimulation of the endogenous lipoid secretion—and since, according to Blair Bell and Borrel, there is a therapeutic action of the lead in cancerous conditions, the following two questions arise: (1) Could a lipoid-genetic medication diminish the toxic effect of the lead, and (2) could a lipoid-genetic medication eliminate the difference in the tolerance limit of various individuals towards the roentgen rays and thus create a single constant maximum tolerance limit?

These questions will form the subject of further investigations.—*T. Leucutia.*

Schwienhorst, Maria. Experiments on the influence of roentgen irradiations on coccus phagocytosis of the reticulo-endothelial system. *Beitr. z. path. Anat. (etc.)*, 1928, lxxxi, 375–390.

It is well known that the parenteral administration of foreign proteins results in a reaction consisting in the formation of antibodies (bacteriolysins and antitoxins) on the one hand, and in a cellular reaction (phagocytosis) on the other. Oller and Domagk called attention to the prominent part the endothelial cells of the liver, spleen and lungs play in this process.

By numerous animal experiments the author studied the effect of roentgen irradiation on the reticulo-endothelial system and the phenomena resulting therefrom. Rats were exposed to large doses of roentgen rays of different wave length and then a known quantity of staphylococci was injected into the femoral vein. According to the time of the injection following the irradiation, the experiments were divided into five groups: (1) irradiation and injection on the same day; (2) injection the day following the irradiation; (3) injection two days following the irradiation; (4) injection three days following the irradiation; (5) injection preliminary to the irradiation.

In general, it was found that roentgen rays influence the cells of the reticulo-endothelial system in such manner that the phagocytosis gradually diminishes until a total insufficiency of the organism is reached.

(1) Normal animals, not irradiated, show a marked phagocytosis of the cocci in the leucocytes, mononuclear and reticulo-endothelial cells, especially in the Kupffer cells. Occasionally an enlargement and regeneration of the Kupffer cells is observed. The free cocci disappear rapidly. (2) Animals injected and killed immediately or shortly (three hours) following irradiation still show good phagocytosis identical to that of the controls. An increase of the phagocytosis and a more rapid disappearance of the cocci were often observed. The spleen showed disintegration of lymphocytes with disappearance of the follicular structures. (3) Animals injected several (one to three) days following the irradiation showed, in addition to severe injury to the spleen, disturbances in other organs. Especially pronounced was the disappearance of the leucocytes from the circulating blood and thus the entire lack of phagocytosis through the leucocytes. In addition to this there was also diminution of the phagocytosis through the reticulo-endothelial system. (4) Animals which were examined later (one to several days) following the injection showed accumulation of cocci in various organs, especially in the capillaries of the liver and spleen. All the animals irradiated died sooner

than the non-irradiated control animals. (5) Confirming the experimental results of Läwen and Hempel a diminution in agglutinin formation was found. The interval elapsing between the irradiation and injection of the cocci is of paramount importance.

It is probable that, due to the injury to the reticulo-endothelial cells, there is a transitory increase in the formation of agglutinins and bacteriolysins in the blood. It may be that the increase of the bacteriolytic capacity of the blood serum such as observed by Heidenhain and Fried following irradiation of localized infections is due also to a similar injury to the reticulo-endothelial system. A direct stimulation of the phagocytes cannot be obtained by irradiation. This coincides with the clinical observation that generalized infection or septicemia never responds to irradiation since here the reticulo-endothelial system has already reached the stage of complete exhaustion.

—*T. Leucutia.*

Simons, Albert. Comparative study of the usefulness of radium carriers in the intratumoral use of radioactive substances. *Strahlentherapie*, 1928, xxix, 711–720.

From a comparative study of different forms of carriers the author comes to the conclusion that Halberstaedter's thorium x rods are at least equal in their possibilities of use to the other preparations used in intratumoral treatment and superior to them in many ways on account of their form. The solid rods are insoluble in body fluids. For this reason if it is desirable to use the whole irradiation any further covering is unnecessary. When they are left in the tissues the foreign body action is comparatively less than that of glass capillaries containing radon, particularly as the elastic threads, when they remain in the tissues a long time swell and take on the consistency of fine catgut. They can easily be cut at any time with scissors. Gold capillaries and needles containing thorium x rods can, unlike hollow needles filled with radioactive salts or radon, have their tips left open. The irradiation from the tip rendered possible in this way is comparatively stronger biologically than the irradiation from the filtered part of the preparation. This seems to be of practical importance in the irradiation of malignant tumors as the danger of inoculation metastases can be decreased by the use of radium carriers with pointed tips.

Simons, Albert, and Strauss, Walter. The action of thorium x rods on bacteria. *Strahlentherapie*, 1928, xxix, 721–729.

Experiments of different kinds on *Prodigiosus* and *Staphylococcus aureus* show that the naked thorium x rods used for therapeutic purposes, especially intratumoral irradiation, with an activity of 0.5 mc. per cm. have an intense bactericidal action. On filtration through gold capillaries 1 mm. in thickness thorium x rods of the same activity had very little effect on the growth of bacteria. When hollow gold needles 3 mm. in thickness were used as filters thorium x rods with twice as strong an action per centimeter had no demonstrable effect on the growth of bacteria. But the radiation coming from the open tip of the gold needles and capillaries was an exception to this. This radiation coming from the uncovered tip of the thorium x rod corresponded to the whole of the complex irradiation of thorium x and sterilized the tissue immediately around the tip completely. This is obviously an advantage that filtered thorium x rods have over closed radium and mesothorium needles of platinum with massive closed tips. The latter, with walls of platinum 0.5 mm. thick and an activity corresponding to that of 1.5 mg. radium element did not have any visible effect on bacteria.

Soiland, Albert. Thermogenesis by radio frequency currents: A preliminary announcement. *Acta radiol.*, 1928, ix, 474–477.

Meland was the first to apply inductive heat, such as that observed in workers around the radio broadcasting station, in therapeutics. The heat that has heretofore been employed for medical purposes has been of the conductive variety. The limitations of the conductive heat because of the changes usually produced on the surfaces of the body are self-evident. With the application of the inductive heat produced by radio frequency currents the temperature of the body can be raised locally or generally without any influence on the surface of the skin. The author, however, thinks that the most important application of this new heat energy will be in connection with the destruction of cancer cells.

The arrangement of the apparatus is essentially a radio transmitting circuit operating with the power up to 1000 watts and a wave length of from 3 to 10 meters. This corresponds to frequencies of from 100 million to 30 million cycles per second. These currents are fed into a condenser which in the practical application consists of two protectively insulated copper foil plates and the tissues of the patient. A rise of body temperature from 5 to 1.5°F. has been obtained without any inconvenience to the patient. The method was used clinically in cases of arthritis where it appears to be superior to diathermy.—*T. Leucutia.*

Starke, H., and Schroeder, R. A static voltmeter for high tensions with a direct

indicator. *Strahlentherapie*, 1928, xxix, 798–802.

The instrument is described and illustrated. Its advantages are that it is static and therefore requires no energy; there is no axis friction and therefore it can be accurately adjusted; it gives measurements for from a few kilovolts up to the highest numbers; it can be easily gauged and controlled; all tensions can be read directly on a scale; it can be used both for continuous and alternating currents.

Strauss, Siegmund. Mecapion, a roentgen dose counter, its applicability and constancy. *Acta radiol.*, 1928, ix, 482–496.

The name "mecapion" expresses that the apparatus measures high ohm resistances (in *me*gohms), *cap*acities, and *ion*ization. The fundamental principle of the instrument is that the ionized thimble chamber slowly discharges a very fine quantity of electricity of a charged condenser and that the discharge of the condenser is automatically recharged to its original potential. This periodic recharge is registered by means of a clock work. The number of the "jumps" of the hands of the clock expresses the total dose given during the irradiation. The recharge of the condenser is done by means of a small electron tube specially constructed. The electron tube is in fact a glow cathode amplifier tube with grid and anode having a special outlet for the recharge. The tube is of highly insulated glass. When the tube is charged to a definite high negative tension by means of a small transformer no anode current can pass through the tube. When the thimble chamber which is connected by a well-insulated tubing system to the grid of the amplifier tube is irradiated the charge of the grid is slowly discharged. The intensity of the discharge is proportional to the intensity of the radiation applied upon the ionization chamber. As soon as the grid current in its discharge has reached a certain minimum value an anode current begins to flow in the tube and a relay which is controlled by this current automatically produces a recharging of the grid to the former high negative tension. The relay at the same time starts in action the switch clock, a light signal and a sound signal, the periodicity of all these signals depending on the rate of the discharge of the condenser and thus indirectly on the intensity of the radiation applied upon the ionization chamber.

Thus the mecapion is really a "dose counter" inasmuch as the periodical change in the discharge and recharge of the condenser sums up the irradiation. Now if the periodicity is so timed that it can express a certain absolute value of the dose, for example, 3 r, then the apparatus becomes a dose meter.

The advantages of the apparatus are as follows: (1) exact dosage of the radiation in r units; automatic warning when the administration of the applied dose is completed; (2) measurement of the intensity of radiation during the course of the treatment; (3) warning in case the filter has been forgotten or too small filter was used, by a change in the tempo of the periodicity of the apparatus; (4) the author claims that the ionization chamber is independent of wave length; (5) it can be used also for the determination of the effective wave length by means of the half-value layer; (6) a specially constructed water phantom is furnished with the instrument for depth dose determinations.—*T. Leucutia.*

Wätjen, J. Pathology of the action of rays in cancer. *Strahlentherapie*, 1928, xxix, 615–633.

The author emphasizes the importance of histological examination in showing the effects of rays in cancer, but at the same time admits that it has very few definitely positive results to show. The tumor, the tissue in which it grows and the patient are a biological unit and the reactions in each and of each upon the other must be considered. He thinks the effect of the rays is due rather to direct action on cancer cells than to action on the surrounding connective tissue. A degenerative effect of the rays on cancer cells has been definitely shown histologically. But similar changes have been seen as a result of spontaneous tissue necrosis. There is an area of inflammation around the irradiated cancer but the histological pictures indicate that it is secondary to the destruction of the cancer cells. Probably general reactions brought about by the products of disintegration of these cells also influence the whole organism. The rays also act on the blood and the blood corpuscles are very sensitive to their action; the blood serum is also affected as shown by changes in its colloid and ion content and histological examination has shown that the endothelial cells of the vessel wall swell and are sometimes cast off into the circulation. Histological examination has not shown any changes in the nerves of the vessels in the irradiated region but that does not prove that none take place. Experiments in general irradiation of animals have shown that the reticulo-endothelial cells are affected, though this has not been proved for local irradiations in man. Actions of the rays on the endocrine glands also probably play a part in the general effect of the rays. The endocrine glands should be protected in irradiation

though sufficiently systematic histological examinations have not been made to show just what structural changes are produced by the rays.

WUCHERPFENNIG, V. Dosage with the barium-platinum-cyanide tablet. *Strahlentherapie*, 1928, xxx, 113–122.

The barium-platinum-cyanide tablet is used for dosage in the Sabouraud-Noiré radiometer and the Holzknecht radiometer. The dependence of these radiometers on wave length was determined with a Küstner dosimeter with irradiations whose hardness varied from 0.3 mm. aluminum half-value layer to 1.5 mm. copper half-value layer. The tests showed that the maximum sensitiveness of the barium-platinum-cyanide tablet lies at about 0.27 Å. The sensitiveness decreases gradually toward the soft side and rapidly in the direction of the harder rays. It might be supposed that the selective coloring of the barium-platinum-cyanide tablets is due to their selective absorption at the edges of the barium and platinum absorption bands, in analogy with what occurs with silver bromide. But this was found to have practically no effect with the mixtures of rays used, whose heterogeneity lay between 1.2 and 2.73. The dependence on wave length is explained by the Comptom effect.

The X values per skin erythema dose were converted into R units and 550 R with rays of varying hardness converted into H and X. A curve is given which shows the number of X or H corresponding to 550 R in the primary irradiation in air with a known hardness of the rays expressed in mm. aluminum half-value layer. The examinations show that the barium-platinum-cyanide tablet is greatly dependent on wave length and cannot be depended on to come within more than 10 per cent of accuracy when the hardness of the rays, expressed in aluminum or copper half-value layer, is accurately known.

ZIMMERMAN, ROBERT. Carcinoma of the cervix and pregnancy and the question of injury of the fetus by rays. *Strahlentherapie*, 1928, xxix, 108–121.

Five cases of carcinoma of the cervix complicated by pregnancy are described; 3 of them came for treatment about the middle of pregnancy and it was impossible to prolong the pregnancy until the child was viable. The child was saved in one of the others and the other woman is now at the end of pregnancy and in good condition. The child in the one case was apparently normal when born and is still so physically but is backward in school.

From his own cases and those in the literature the author concludes that in beginning pregnancy with carcinoma of the cervix only the mother's interests are to be considered, as there is little probability of saving the child; so total extirpation is indicated even in young women. If the chances for operation are doubtful or bad, intense roentgen or radium irradiation with local cauterization of the tumor is indicated. In advanced pregnancy where there is hope for the child its interests must be considered, even at the expense of the mother if the prognosis of the cancer is bad. In circumscribed, not very far advanced carcinomas of the portio, cauterization with the cautery only slightly red is the best method. Very intense heat should be avoided, as it may not only injure the fetus but by charring the tissue at the surface prevent its action on the deeper tissue. If the carcinoma extends to the cervix, a combination of the cautery and radium is indicated. If the greater part of the cervix is involved only radium is used, as burning away the cervix increases the danger of abortion.

Rapidly growing tissue is particularly sensitive to rays so of course the fetus is very radiosensitive. A considerable number of injuries of the fetus by roentgen rays have been published and a smaller number by radium. Sometimes when the children are apparently normal and develop well physically, their mental development seems to be retarded later. If careful investigation should show that any considerable number of these injuries are really due to the action of the rays the indications must be revised.

ZUPPINGER, A. Radiobiological examinations of ascarid eggs. *Strahlentherapie*, 1928, xxviii, 639–756.

Some of the more important biological methods of testing rays are criticized. Particularly in experiments with a small material it is necessary to allow in the results for variations in statistics. Too little attention has been paid so far to the requirement of genotypic purity of the material examined. The ascarid method is then described in detail. The sensitiveness of ascarid ova to rays is dependent to a great extent on external factors, but with sufficient care these can be excluded so that the method gives reliable results. With beginning gastrulation there is a stage of increased sensitiveness to roentgen rays. Changes in sensitiveness to ultraviolet rays do not begin until after gastrulation. But experiments show that this difference is not enough to prove a different mechanism of

action of roentgen rays and ultraviolet rays. A given amount of rays in fractional doses over a period of ten days has about twice as much biological effect as the same dosage given all at once. Short wave rays with the same dosage measured with the Küstner instrument have a stronger biological action on ascarid eggs than soft rays. A mathematical and a biological method of determining the distribution of intensity in a medical radium preparation are described; the values obtained by the two methods agree well enough for practical purposes. The biological method makes it possible to determine the dosage yielded at different distances from the radium carrier expressed in the dosage units of roentgen irradiation. The curve of injury of ascarid eggs by different dosages of rays is analyzed and a mathematical-biological method of explaining the action of the rays discussed; a deviation from the theoretical curve can be explained by this method.

Zwaardemaker, H. Irradiation and automatins in the double heart experiment. *Strahlentherapie*, 1927, xxvii, 413–425.

In a recent report the author proved the existence of a chemical connecting link between irradiation and the functional results in the heart experiment. He gave this chemical connecting link the name of automatin, and as the substance is not the same for alpha and beta irradiation he gives the word in the plural in this article.

In an artificially irradiated heart (donor's heart) molecules that produce automatin are activated by irradiation and after a certain latent period become effective. The activated molecules enter the circulation as automatin and in a second heart interposed in the same circulation (receiver's heart) they cause regular pulsations after a short interval. The latent periods are to a great extent dependent on the perfusion time and as a consequence a decrease in the available supply of automatin. Physiological radio-antagonism seems to be due to an antagonism between the alpha and beta automatins.

Zwaardemaker, H., and Feenstra, T. P. Roentgen rays and automatism of the heart. *Strahlentherapie*, 1928, xxix, 527–533.

A heart which was being perfused with Ringer's solution that did not contain potassium and which had come to a standstill because of lack of automatin was irradiated with cathode rays with an aluminum window 8 microns thick and 2000 volts tension in the vacuum tube; it was reactivated in all cases, and in a third of the cases the pulsation lasted on an average for seven hours. Under the same conditions the heart was reactivated in 70 per cent of the cases by very soft roentgen rays with an aluminum window 40 microns thick and a tension of 2000 volts in the vacuum tube and the pulsation continued for an average of twenty hours. In both cases the restoration of function was probably due to activation by the irradiation of the automatinogen that was still present in the heart. That the immediate action of the cathode rays was greatest and the after-effect most pronounced with roentgen rays was probably due to the fact that the former produced a larger amount of automatin.